THE ECONOMY OF

MAINE

AND THE

PASSAMAQUODDY

TIDAL POWER PROJECT

A REPORT TO THE
CORPS OF ENGINEERS, U. S. ARMY
FOR THE INTERNATIONAL PASSAMAQUODDY
TIDAL POWER SURVEY OF 1 OCTOBER 1959

DECEMBER 1958
C-61135

Arthur D. Little, Inc.

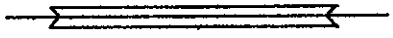
THE ECONOMY OF

MAINE

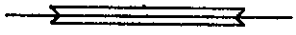
AND THE

PASSAMAQUODDY

TIDAL POWER PROJECT



A REPORT TO THE
CORPS OF ENGINEERS, U. S. ARMY
FOR THE INTERNATIONAL PASSAMAQUODDY
TIDAL POWER SURVEY OF 1 OCTOBER 1959



DECEMBER 1958
C-61135

Arthur D. Little, Inc.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

PART ONE

LIST OF TABLES (Continued)

PART ONE

LIST OF TABLES (Continued)

PART ONE

LIST OF TABLES (Continued)

PART ONE

LIST OF TABLES (Continued)

PART ONE

LIST OF TABLES

LIST OF FIGURES

TABLE XXXVI

MAINE LANDINGS OF OCEAN PERCH

Year	Pounds
1941	20,726,758
1942	26,446,755
1943	25,792,734
1944	24,267,951
1945	27,806,599
1946	41,076,852
1947	39,988,130
1948	49,041,410
1949	55,502,605
1950	79,281,327
1951	73,941,835
1952	60,468,154
1953	60,623,164
1954	79,670,711
1955	67,684,954
1956	64,966,871

SUMMARY OF FINDINGS

The purpose of this regional survey has been to identify those trends in the economy of Maine that would affect future requirements for electric power in the state. In addition to our survey of the significant sectors of Maine's economy, we have investigated a total of 18 "target" industries to ascertain whether they might be attracted to the Passamaquoddy area by the availability of low-cost power or the combination of power with other favorable locational factors. Finally, we undertook to estimate the impact of the Passamaquoddy development on the economy of Maine in general and on the level of economic activity in Washington County in particular.

Population changes are both a cause and an effect of changes in the rate of a region's economic growth. It is significant, therefore, that Maine's population is increasing less rapidly than that of the United States as a whole and that, according to our projections, its rate of growth will fall even farther behind that of the nation in the foreseeable future. Out-migration has been the chief reason for the state's lagging growth rate. Its most clearly identifiable cause continues to be the lack of economic opportunity particularly in the rural areas in which a larger share of Maine's population is concentrated than in either New England or in the country as a whole. Maine has only one standard metropolitan area and a few smaller urban centers capable of absorbing the unemployed and the under-employed rural surplus population. Although the establishment of new industries and the growth of existing ones could conceivably slow down the rate of out-migration of the population in the prime working age groups, the nation-wide trend toward greatly accelerated concentration of the population in the leading metropolitan centers will tend to militate against the state's ability to keep and to attract skilled members of the labor force.

Our survey of the primary sectors of the economy did not reveal any unusual growth factors based upon Maine's natural resources. Farm income is more important to Maine than to either New England or to the United States as a whole. In the past, Maine agriculture has been dominated by the potato crop. In the face of rising output in other parts of the country, Maine has maintained its position as the leading potato-producing state because of tremendous increases in yields on reduced acreage. Even so, perhaps the most encouraging development in Maine agriculture has been that poultry and poultry products recently displaced potatoes as the primary source of farm income. Because of the spectacular success of Maine broilers in the metropolitan areas of the northeastern seaboard, the state has succeeded in reducing the impact of chronically fluctuating potato prices on the farming community. Maine is currently

in the throes of a shift from subsistence to commercial farming which took place in other northeastern states at least two decades ago. As Maine farmers adopt the new technology and increasingly mechanize their operations, realized net income per farm is likely to be maintained slightly above the U. S. average. Moreover, the output of specialty products, on which the future health of the state's agricultural economy depends, will be regulated more and more by the capability of processing plants and the development of improved distribution and packaging techniques to meet the requirements of the service-conscious ultimate consumer. The general outlook for Maine agriculture may thus be described as mildly favorable.

Fishing is historically one of the most important segments of the Maine economy. In recent years, Maine fishermen have become responsive to changes in consumer demand. While per capita consumption of fish in the United States has decreased, the volume of landings has increased in response to the total population growth. This trend may be expected to continue. Imported frozen groundfish fillets will capture most of this increase. Growth is also expected in Maine's lobster industry while the sardine industry may be facing a short-term decline. Of long-range interest is the possible reduction of herring into an edible high-protein meal designed for human consumption in the less developed tropical and subtropical parts of the world that suffer from protein deficiency. The herring fishery accounts for about 85% of total landings in Washington County and provides the major source of employment in the Passamaquoddy area. Despite its violent fluctuations, this industry offers stability to the community in which the processing plants are located. Housewives make up the bulk of employment and although their wages are low, they serve to supplement family incomes. Moreover, the low cost of fish processing along the Maine coast is the principal insurance of the industry's continued stability.

No substantial increase in mining activity and the mineral industry can be expected in Maine unless new discoveries are made or technological developments occur in the recovery of sulfur, base metals, and manganese. On the basis of present indications, it would take a wartime emergency or an unanticipated increase in the price of imported ores to stimulate the utilization of Maine's submarginal deposits. As detailed calculations in Part Two have revealed, there appears to be no foreseeable opportunity for an advantageous industrial operation using the extensive low-grade Maine ores and Passamaquoddy power to produce a manganese concentrate.

The growth of manufacturing in Maine has been hampered by a set of adverse factors that include shortage of raw materials, distance

from markets, the high cost of fuel and power, and the consequent difficulty of meeting competition from the more rapidly industrializing parts of the country. Natural-resource-oriented industries have fared best in the recent past. The forest-products industry, which overshadows all other manufacturing in the state, has experienced substantial growth, but its future expansion is limited by the quantity and quality of the available raw material and by the lack of progressive forest management methods. In the food-processing industry, on the other hand, a marked trend toward greater efficiency can be discerned, and substantial growth in such activities as poultry and potato processing can be expected. Maine's two other industries--leather and textiles--are declining industries in New England. The leather industry in Maine has held its own in the face of a nationwide decline only because of the low prevalent wage scale. In summary, those of the state's industries that are based on local raw materials or aim to serve nearby metropolitan markets offer some promise of growth, while those located in the state chiefly because of lower labor costs face an uncertain future.

Among the so-called tertiary or service industries, the recreation and tourist business deserves special attention as a buoyant sector in the Maine economy. It also merits special consideration because of the Passamaquoddy Tidal Power Project's potential attraction for tourists and recreationists. Because of the nationwide trend toward increasing outdoor recreation, both private and public facilities have expanded rapidly since the end of World War II, especially in the traditional vacation areas. The vacation business has long been an important buttress of the Maine economy, with the state's gross income from this business rising from $135 million in 1950 to $272 million in 1957, according to official figures. Although it is difficult to achieve an accurate measurement of the impact of recreation upon a state's economy, we feel confident in projecting an annual increase of 5% in Maine's tourist business for the decade of the 1960's. Our optimistic projection is based on the assumption that the seasonal and locational disadvantages of Maine's recreational resources and their lack of development will be counterbalanced by increased "open space" needs for week ends and short vacations within easy reach of the Atlantic seaboard serving the metropolitan population.

In order to estimate the number of tourists who might be attracted to so unique an engineering installation as the Passamaquoddy Tidal Power Project, we have assumed that most nonlocal border crossers at Calais, Maine, would stop off at the site and that perhaps one quarter of those visiting Acadia National Park would continue their trip to take in Passamaquoddy. On this assumption, the Passamaquoddy project, had it been completed, might have attracted as many as 800,000 visitors during the summer months of 1957. The length of these tourists' visits and the

amount of per-capita spending at or near the site would depend on the availability of recreational and service facilities in the vicinity of the project. It is evident, therefore, that the increased tourist activity generated by Passamaquoddy would have an important effect upon the economic activity in Washington County.

Our survey of 18 industries that might locate in the vicinity of Passamaquoddy has led us to conclude that a substantial majority would not be attracted to the area by the availability of electric power at any economic rate. Of those that might consider a Maine location if power were available in sufficient quantity, a maximum rate of 3.5 mills per kilowatt-hour at source might make an aluminum or a manganese reduction facility competitive with plants in other parts of the country. If the minimum cost at which Passamaquoddy power became available is raised to 4 mills per kilowatt-hour, power alone would no longer attract any industry to this site. Although the production of manganese might still be competitive at this rate, the decision to locate such a plant near Passamaquoddy would depend primarily on a technological breakthrough that would bring the low-grade manganese deposits of Maine and New Brunswick within reach of commercial exploitation.

In conclusion, we are of the opinion that the growth of the Maine economy to 1970 will not equal that of the United States as a whole. To assess the impact of the Passamaquoddy project, we have projected the normal growth of per-capita income in Maine for comparison with additions to personal income resulting from construction of the project. We have found that the impact would be limited to an increment of 2% in annual incomes by 1965 and 1.8% by 1970 over and above the normal projected figures. We do not believe that these additions to income will exercise a significant influence on the course of Maine's economic development.

The short-run effect of the construction phase of the project on Washington County, on the other hand, would be substantial. In the long run, however, the higher wages accompanying the increase in economic activity in the county might well threaten the continued existence of established industries (garment making and food processing). With the exception of an increase in toruist expenditures, the impact of the operation of the tidal power project on the local economy would become significant only in the event that electric power is made available to industry at 3.5 mills per kilowatt-hour.

PART ONE

SURVEY OF THE MAINE ECONOMY

I. INTRODUCTION

Since the end of World War I, the New England economy has grown less rapidly than that of the nation as a whole, and Maine has shared in this relatively slower growth. Output, employment, and per-capita personal income have continued to rise, but many other areas of the country have advanced substantially more rapidly. Since this process and the problems it has raised have been discussed in many books and reports,* only a brief review of the broad trends is presented here.

During the 19th century, New England--the leading industrial area of the United States--exported her manufactured products to all parts of the nation and many foreign countries. Since that time, however, population growth in other areas--particularly the central and southeastern regions--has attracted industry to newer and expanding market areas at the expense of New England. Except for Connecticut, Maine has suffered less from this industrial shift than any other New England state. Its industrial structure, nevertheless, reflects this basic problem of the New England economy.

Of its four major manufacturing industries, two--textiles and leather--seem likely to continue to decline as a result of expansion elsewhere. The growing forest-products industry will, in our opinion, expand at a slower rate than the U. S. economy as a whole, while food processing, which employed 9.5% of the total workers in manufacturing industry in 1957, is likely to grow at least as rapidly as the nation's population, although its employment declined from 10,900 in 1953 to 9476 in 1957.

Other segments of the economy--except specialized agriculture and tourism--do not exhibit important growth trends, and we find it difficult to believe that Maine's economic growth will keep pace with the economy of the rest of the United States. The discovery of substantial mineral deposits might invalidate this conclusion, but there is no present justification for projecting any significant change in Maine's mining activity.

We feel that the economic outlook for Washington County is not likely to improve significantly. It suffers--even more severely than the rest of the state--from the locational difficulties that will continue to inhibit Maine's economic development. In 1950, median family income was 28% below the state's median income, and in 1956, the gross annual average

---

* See, for example, "The Economics of New England," Seymour E. Harris, Harvard University Press, 1952; "The Economic State of New England," National Planning Association, Yale University Press, 1954; and "Regional Trends in the U. S. Economy," U. S. Department of Commerce, 1951.

wage for manufacturing was $2805 compared with $3413 for the state. Unemployment is high, although the seasonal labor needs of the local food-processing industry reduce the problem in the summer months.

Unfortunately, there is little reason to anticipate a significant change--at least in an upward direction. For reasons explained in Part One, Section VI, expansion of the forest-products industry is highly improbable. The garment industry might increase its employment as wage rates in other regions of the United States continue to rise, but a general improvement in the economic health of the county, with a concomitant increase in wage levels, might drive the industry away, since it is notoriously responsive to changes in labor costs. The downward trend in the fish-processing industry might be reversed by aggressive management policies, but transportation costs will continue to inhibit growth.

In the normal course of events, depopulation may be expected to continue in Washington County at an annual rate of perhaps 1%, at least until the recent trend toward increased "ruralization" can be reversed. More than three fourths of the county's population was classified as rural in 1950, as compared with less than half the state's population at the same date. For commercial agriculture as for recreation and tourism, the county suffers from its outlying location.

II. POPULATION

The population of Maine has not kept pace with the national rate of growth. (See Table I.) Whereas in 1900, the state made up almost 1% of the U. S. total, it now contains just over 0.5% of the nation's 175 million people. At the last census, in 1950, the population of Maine was almost 914,000, an increase of 32% over 1900; during the same period, however, the U. S. growth was 98%. The population of the six New England states, taken as a unit, has also grown more rapidly than the population of Maine. Moreover, intercensal data for 1950-55 indicate that Maine is falling even farther behind the nation in the current population boom.

It will be noted that in the same 50-year period, Washington County's decline in population amounted to 22% of the 1900 total. Its population remained fairly stable only during the Depression, when the national trend in rural-urban migration was temporarily reversed. (See Table II.) In the 1940-1950 decade, it was one of two counties, both in the southeastern part of the state, to experience a decline in population, while the more heavily populated southwestern counties experienced gains ranging from 9% to 16%. (See Figure 1.)

Since 1950, the southeastern counties have declined at an accelerated rate. It took only six years (1950 to 1956) for Washington County to register a net loss equal to the decrease of the entire preceding decade. Figures 1 and 2 illustrate the differences in rates of growth between the predominantly urban and industrial counties and the sparsely settled rural sections of the state.

A. CHARACTERISTICS

The following survey of population characteristics--rural-urban distribution, age distribution, educational level, and occupational groupings--suggests some of the reasons for the state's lag behind national rates of growth.

1. Rural-Urban Distribution

In 1950, Maine had a larger proportion (48.3%) of its population in rural areas than either New England (23.8%) or the country as a whole (36%). Moreover, during the last half-century the decline in the proportion of rural residents in Maine (1900-1950 decrease 27.3%) has been considerably slower than that in the United States (40.3%). New England as a unit is,

TABLE I

COMPARATIVE POPULATION TRENDS FOR THE UNITED STATES, NEW ENGLAND, MAINE, AND WASHINGTON COUNTY

A. Number of Inhabitants at Census Dates (in thousands):

	1900	1920	1930	1940	1950
United States	75,995	105,711	121,770	131,954	150,697
New England	5,592	7,401	8,130	8,427	9,314
Maine	694	742	797	847	914
Washington County	45	42	38	38	35

B. Percentage Change in Selected Periods:

	1900-1950	1940-1950	1950-1955*
United States	98.4	14.0	9.0
New England	66.5	10.0	4.1
Maine	31.7	7.9	2.2
Washington County	-22.0	-6.8	-5.7

C. Decennial Percentage Increase of Population, 1900-1950:

	1900-10	1910-20	1920-30	1930-40	1940-50
United States	21.0	14.9	16.1	7.2	14.0
New England	17.2	12.9	10.3	3.3	10.0
Maine	6.9	3.5	3.8	6.2	7.9

* Based on 1955 intercensal population estimates.

Source: Bureau of the Census.

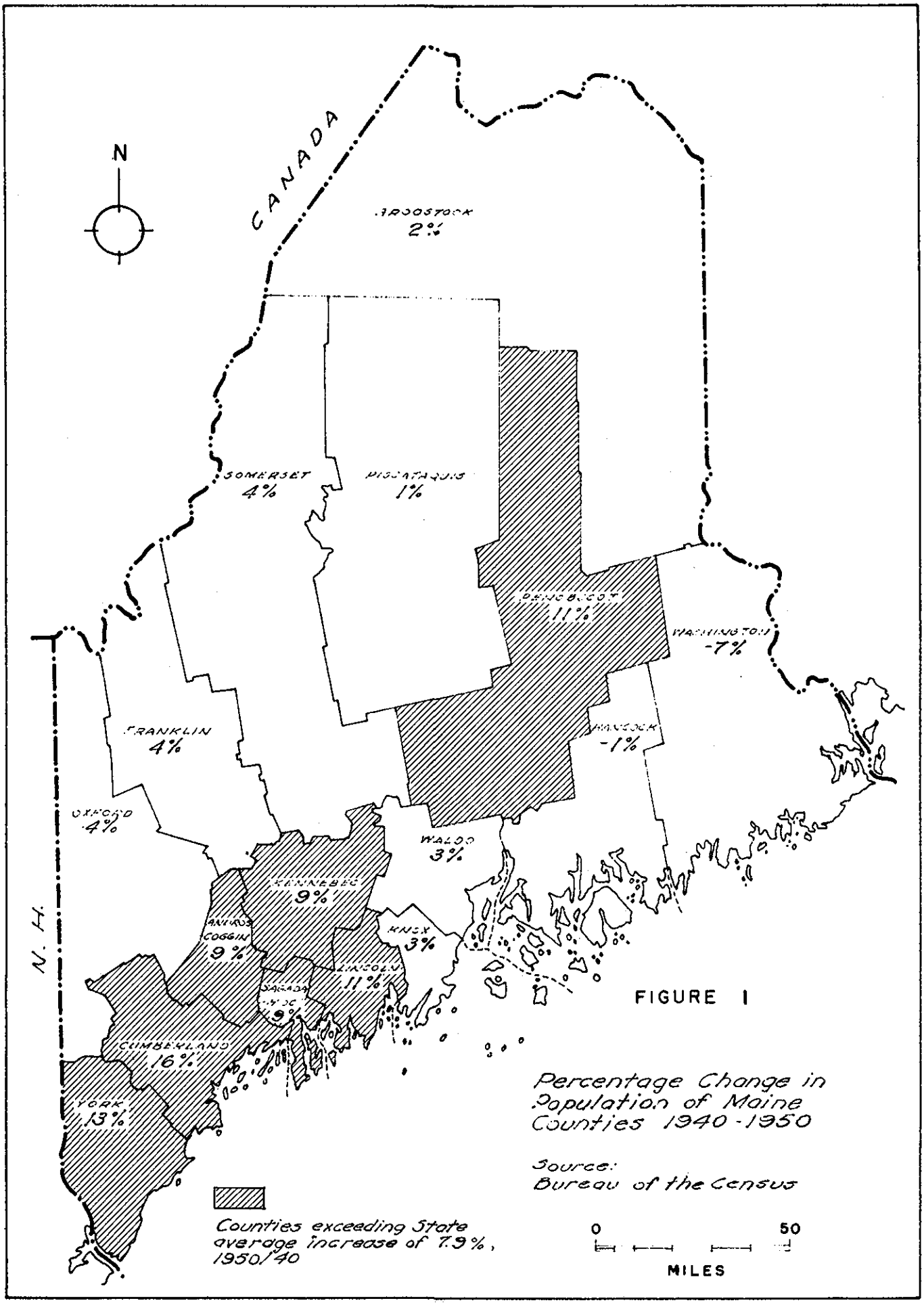


FIGURE 1

Percentage Change in Population of Maine Counties 1940-1950

Source:
Bureau of the Census

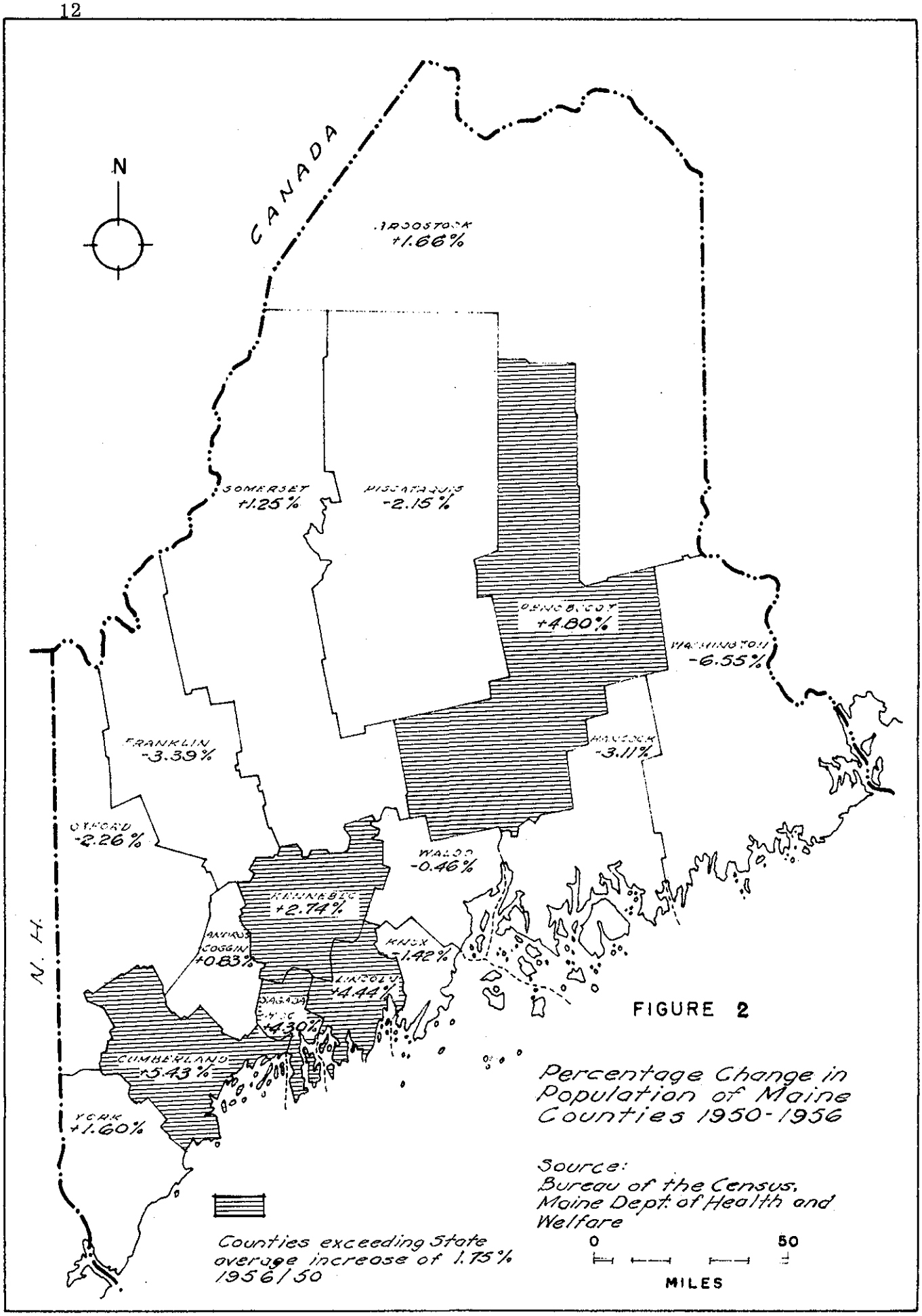


FIGURE 2

Percentage Change in Population of Maine Counties 1950-1956

Source:
Bureau of the Census,
Maine Dept. of Health and Welfare

of course, even more urbanized than the nation as a whole (see Table II), and the disparity in rural-urban distribution between Maine and the southern New England states requires little documentation. In 1950, Maine's only standard metropolitan area (Portland) contained 13% of the state's population; in the same year, 79% of the people of Massachusetts, Connecticut, and Rhode Island lived in 16 standard metropolitan areas, and all but one were larger than Portland. At a time when interstate migration is heavily weighted by a movement from the countryside to the town, the large, rural component in Maine constitutes a continuing source of out-migration. (See Section II-B.) Table II indicates that heavy out-migration from Washington County has resulted in an actual increase in the proportion of people residing in rural areas.

TABLE II

URBAN-RURAL DISTRIBUTION, 1900-1950

	% Urban				% Rural			
	1900	1930	1940	1950	1900	1930	1940	1950
United States	39.7	56.2	56.5	64.0	60.3	43.8	43.5	36.0
New England	68.6	77.3	76.1	76.2	31.4	22.7	23.9	23.8
Maine	33.5	40.3	40.5	51.7	66.5	59.7	59.5	48.3
Washington County	--	23.6	22.5	21.9	--	76.4	77.5	78.1

Source: Bureau of the Census.

2. Age Distribution

As shown in Table III, Maine has proportionally more inhabitants in the less productive age groups than either New England or the United States as a whole. Conversely, in 1955 a smaller percentage (54.2%) of Maine's population was in the age bracket 18-64, which constitutes the major portion of the working population, whereas 57.5% of the U. S. population and 58% of New England's were in this category.

The proportion of older people in the United States has been growing. In Maine between 1930 and 1955, those 65 and over have grown from 8.8% to 10.9% of the total population. Its relatively larger share of people

TABLE III

AGE DISTRIBUTION OF POPULATION: UNITED STATES, NEW ENGLAND, AND MAINE

Percent of Total	1930 United States	1930 New England	1930 Maine	1950 United States	1950 New England	1950 Maine
Under 18	35.0	32.5	34.0	31.0	28.2	32.4
18 - 64	59.6	60.8	57.4	60.9	62.0	57.3
65 and over	5.4	6.7	8.8	8.1	9.8	10.3
	100.0	100.0	100.0	100.0	100.0	100.0

Percent of Total	1955 (estimated) United States	1955 (estimated) New England	1955 (estimated) Maine
Under 18	34.0	31.4	34.9
18 - 64	57.5	58.4	54.2
65 and over	8.5	10.2	10.9
	100.0	100.0	100.0

Source: Bureau of the Census.

The 1955 estimate is based on Current Population Reports, Population Estimates, Series P-25, No. 160.

in the less productive and dependent age groups is chiefly the result of the out-migration of young adults. The marked difference in age-group distribution between Maine, the southern New England states, and the nation as a whole provides a partial explanation for the state's lower per-capita income.

In Washington County, the percentage of people 65 years of age and over (12.1% in 1950) was even larger than that for the state as a whole. Because the area has only limited opportunities for industrial employment, out-migration has cut heavily into the most productive age groups and thus increased the proportion of the dependent and older classes.

3. Educational Level

It is not possible to compare the knowledge of large groups of people directly, but the number of years of formal education received provides an indirect measure. In Maine, which next to Massachusetts has the highest New England record of educational achievement, the average person 25 years of age or older had completed 10.2 years of school in 1950. The comparable figure for the United States was 9.3 years. (See Table IV.)

On the whole, the level of education in Maine compares favorably with that in other parts of the country with similar age structure, income levels, and industrial composition. It should be remembered that Maine has a larger share of older people than the rest of the United States and that a few decades ago many more people dropped out of school at an earlier age than today's students do. This tends to pull down the average number of school years completed in an area with a substantial proportion of older residents. Moreover, educational achievement is usually lower in rural districts than in urban centers; this fact likewise tends to pull down the average number of school years completed in a state that, up to 1950, reported more than half its population as rural residents. In view of the "depressing" effect of these demographic characteristics, Maine's record of school years completed is good and, but for the out-migration of its younger adults, would be indicative of a well-educated labor force.

Unfortunately, however, Maine, along with the rest of New England, lags behind other parts of the nation in its vocational education effort. In 1950, the proportion of such students was less than the percentage of school-age population. According to the New England Council, "The region's relatively small enrollment in vocational education classes compared to population and industrial distribution suggests that New England is not adequately providing for the training of the skilled workers which its

TABLE IV

MEDIAN SCHOOL YEARS COMPLETED BY RESIDENTS 25 YEARS OLD AND OVER

A. Median School Years Completed

	1950	1940
United States	9.3	8.4
New England	10.4	8.8
Maine	10.2	9.0
Washington County	10.0	-

B. By Areas in Selected States, 1950

	State Median	Urban	Rural Nonfarm	Rural Farm
Maine	10.2	10.4	10.2	9.5
Massachusetts	10.9	10.8	9.9	8.9
Ohio	9.9	10.2	9.3	8.8
South Carolina	7.6	8.9	7.3	6.3
Colorado*	11.6	12.0	10.1	9.1
California*	10.9	11.8	9.4	8.9

*High figure in western states reflects the "young" age distribution of the population.

Source: Bureau of the Census.

industries require . . . . Not only must replacement workers be provided, but the attractiveness of the region to prospective employers will be enhanced if they can count upon the vocational schools to furnish them with well-trained craftsmen."

Despite a preponderantly rural population, Washington County's median number of school years completed is 10, which is not significantly below the level for the state and still above the national average.

4. Occupational Groupings

A comparison of occupational characteristics for the country, Maine, and Washington County at the last census date is presented in Table V. It indicates that the level of skills in Maine (and to a much greater extent in Washington County) is below the national average. More than 38% of Maine's employed labor force consists of laborers and operatives (the latter are essentially semiskilled industrial workers), whereas only 28.5% of those employed in the country as a whole are listed in these categories. This disparity reflects the lack of economic opportunity and the loss of the more enterprising and skilled members of the labor force to other parts of the nation.

B. MOBILITY

1. Intercensal Deficits

As noted earlier, the substantial rate of out-migration, especially among the younger age groups and skilled workers, has been one of the most disturbing aspects of Maine's long-term population shifts. Residents of Maine have been leaving the state in considerable numbers throughout the 80-year period for which comparable statistical data are available. Table VI-A shows that Maine suffered a net loss due to migration for every decade except the years 1890-1910. The intercensal deficit ranged from a high of 39,300 in the prosperous 1920's to a low of 1200 in the depression decade of the 1930's. Even in the two decades for which Table VI-B records a net gain from migration, there was actually no reversal in the exodus. A breakdown of migrants by place of birth (Table VI-C) reveals that between 1890 and 1910 more than 53,000 foreign-born whites (predominantly Canadians) entered the state; hence, they more than offset the simultaneous out-migration of almost 40,000 persons born in Maine. It is interesting to note in this connection that whereas more than half of the native out-migrants were in the 25-44 age group, the immigrants tended to be concentrated in

TABLE V

DISTRIBUTION OF EMPLOYED LABOR FORCE BY OCCUPATION, UNITED STATES, MAINE, AND WASHINGTON COUNTY, 1950

Occupation	Percentage of Total Employed		
	United States	Maine	Washington County
Professional and technical	8.7	7.6	6.7
Farmers and farm managers	7.7	5.4	5.7
Managers, officers, proprietors, etc.	8.9	8.7	9.7
Craftsmen, foremen	13.8	13.1	11.3
Clerical and kindred	12.3	9.4	6.9
Sales	7.0	6.8	5.8
Operatives and kindred	19.8	25.4	17.9
Service	7.6	6.3	4.3
Farm laborers	2.6	3.1	1.8
Laborers, except farm and mine	6.1	10.2	26.2
Total employed	56,239,000	312,326	10,134
Unemployed, as Percentage of Labor Force	4.7	8.7	19.4

Source: Bureau of the Census.

TABLE VI

NET INTERCENSAL MIGRATION AND RATE OF NET MIGRATION
BY AGE AND PLACE OF BIRTH, MAINE, 1870-1950

A. Net Migration - Numbers

Age Groups at End of Decade	1870-80	1880-90	1890-1900	1900-10	1910-20	1920-30	1930-40	1940-50
10-14	- 2,800	- 400	1,200	1,500	- 400	- 2,400	1,000	- 1,700
15-24	- 8,200	- 100	4,400	5,800	- 500	-10,700	- 4,300	-11,900
25-44	-21,400	-14,200	- 4,400	400	- 5,500	-20,300	200	-18,400
45-64	- 2,400	- 700	2,400	2,100	- 400	- 3,100	4,400	- 900
65+	1,600	- 500	600	900	- 1,400	- 2,700	- 2,400	- 3,000
Total*	-33,300	-15,900	4,100	10,600	- 8,300	-39,300	- 1,200	-35,800

B. Net Migration per 1000 Average Population

10-14	- 42	- 6	20	23	- 6	- 33	13	- 24
15-24	- 63	- 1	35	46	- 4	- 79	- 29	- 83
25-44	- 111	- 71	- 21	2	- 25	- 92	1	- 73
45-64	- 20	- 5	17	14	- 3	- 18	24	- 5
65+	24	- 7	7	11	- 16	- 28	- 22	- 24
Total	- 58	- 27	7	16	- 12	- 56	- 2	- 46

C. Net Migration by Migrants' Place of Birth

Native White	-46,500	-40,800	-20,600	-18,400	-22,700	-46,600	- 2,200	-41,600
Foreign-born White	13,400	25,000	24,400	28,900	14,300	7,500	800	5,900

*Small differences in totals are due to rounding.

Source: Population Redistribution and Economic Growth, United States, 1870-1950, Vol. I, American Philosophical Society, Philadelphia, 1957, p. 149.

the 15-24 age bracket. Since most of Maine's foreign-born residents settled in the towns and joined the labor force as factory operatives, it may be safe to assume that over the course of several decades the educational level and vocational skills of the economically productive segment of the population were not enhanced by this exchange of people.

After a near halt in net migration during the years of the Great Depression, when many former out-migrants returned to their family homes and farms, the decade of the 1940's experienced a resurgence of the exodus that has been under way ever since. Table VI-B shows the impact of the movement upon the state's young adult population, whose reduced total shows the effects of the low birth rate of the 1930's and wartime losses.

2. Postcensal Estimates

Although postcensal estimates of net migration are subject to considerably greater percentage error than those for the other components of population change, it is evident that the rate of out-migration from Maine has quickened since 1950. It appears that by 1956 the state had lost 6.4% of its 1950 population to other parts of the United States, a figure exceeded only by Vermont (10.2%), West Virginia (12.1%), and North Dakota (8.5%).* The number of people leaving Maine thus fell only somewhat short of the total number of deaths recorded in the state between 1950 and 1956. (See Table VII.)

Of special future significance is the effect of current migration rates on the best trained and potentially most productive segment of the state's population. In order to assess this effect, the Bureau of the Census prepared a set of projections of the population 18 to 24 years old, using three different assumptions regarding the pattern and level of future interstate migration. The results of this projection for the state of Maine are shown in Table VIII. If there were no net migration, the 1973 population of those in age group 18 to 24 would be 145,000, a gain of 46% from 1950. If, on the other hand, the 1940-1950 pattern of migration were to be maintained, by 1973 this age group would amount to only 133,000--an estimated loss of 12,000 due to out-migration.

There is no equivalent data on population mobility for Washington County. However, the Census Bureau provides some information on the

* Five southern states also lost a larger percentage of their 1950 population to migration than Maine, but these losses reflect primarily the massive postwar movement of Negroes to northern cities.

TABLE VII

ESTIMATES OF THE COMPONENTS OF CHANGE IN THE TOTAL POPULATION OF THE UNITED STATES, NEW ENGLAND, AND MAINE, APRIL 1, 1950, TO JULY 1, 1956

	Net Change				Net Total Migration	
	Number	Percentage of 1950 Population	Births	Deaths	Number	Percentage of 1950 Population
United States	+16,561,000	+11.0	24,622,000	9,383,000	1,323,000*	+0.9
New England	+ 430,000	+ 4.6	1,333,000	636,000	- 267,000**	-2.9
Maine	+ 17,000	+ 1.8	138,000	63,000	- 58,000***	-6.4

* Net immigration from abroad.

** Net interregional migration.

*** Net interstate migration.

Source: Bureau of the Census, Current Population Reports, Population Estimates, Series P-25, No. 165, November 4, 1957.

TABLE VIII

PROJECTIONS OF THE POPULATION OF MAINE IN THE 18-24 AGE GROUP, 1958 TO 1973

	Migration Such as That in: 1940-50	1930-50	No Net Migration
1950*	99,000	99,000	99,000
1958	94,000	95,000	99,000
1963	102,000	104,000	110,000
1968	124,000	127,000	136,000
1973	133,000	136,000	145,000

* Enumerated population, April 1, 1950.

Source: Bureau of the Census, Current Population Reports, Population Estimates, Series P-25, No. 132, February 20, 1956.

age distribution of migrants by state economic areas. In this tabulation, based on a 20% sample of the mobile population during the year preceding the 1950 census, Washington County is grouped with four other coastal counties (which have a better record of population growth for the decade 1940-50) into Area 3. Hence, the migration data in Table IX does not provide an accurate picture of the mobility and age distribution of migrants in Washington County. Nevertheless, Table IX shows that those who left the area were predominantly in the younger age groups.

C. PROJECTIONS

The population of Maine has been projected to 1970 on the basis of three sets of assumptions detailed below. Changes in the regional distribution of people within the United States are a function of: (1) birth and death rates by states, and (2) internal (i.e., interstate) migration. These demographic changes, however, have their origin in social and economic causes. Since internal migration, far more than natural increase, is responsible for the variability in growth rates among the states, it is important to give careful consideration to this component in making population projections by states. Changes in economic conditions are basic here, since long-distance migration is largely a product of regional differences in job opportunities. Redistribution of the nation's population is therefore sure to continue, bringing changing regional labor requirements into balance with the numbers and types of available workers in each labor market area. Although entirely new patterns of industrial location might result from technological change, the pattern of population redistribution will continue to remain unpredictable.

We have thus based our projections wholly on the three demographic variables (fertility, mortality, and migration), but have taken foreseeable economic conditions in Maine into consideration to the extent that they are reflected in the rate of out-migration. Of the three projections made, Series I has been selected for the economic forecasts in Part Three of this report.

1. Assumptions and Method

A "component" method was used to develop the projections shown in Table X. This method involves the preparation of separate projections of each of the components of population change. The procedure consisted of carrying forward, by five-year time periods, an estimate of the population of the state for July 1, 1955, on the basis of certain assumptions concerning each of the components for future years.

TABLE IX

AGE CHARACTERISTICS OF MOBILE POPULATION BY STATE ECONOMIC AREAS, 1950

	Area 2 - Franklin, Oxford, Penobscot, Piscataquis, Somerset Counties		Area 3 - Hancock, Knox, Lincoln, Waldo, Washington Counties	
	In-Migrant	Out-Migrant	In-Migrant	Out-Migrant
Total Number	7,285	8,465	3,920	4,310
17 and under	1,805	2,030	1,025	1,245
% of total	25	24	26	29
18-29	2,825	3,705	1,185	1,485
% of total	39	44	30	34
30-44	1,455	1,660	810	700
% of total	20	20	21	16
45 and over	1,200	1,070	900	880
% of total	16	13	23	20

Source: Bureau of the Census.

TABLE X

PROJECTIONS OF THE POPULATION OF MAINE, 1955 TO 1970

	1955	1960	1965	1970
Series I	920,000	945,000	970,000	1,008,000
Series II	920,000	958,000	996,000	1,044,000
Series III	920,000	951,000	975,000	1,001,000

Source: Arthur D. Little, Inc., as adapted from Bureau of the Census projections.

The specific combinations of assumptions used in each of the series projected to 1970 are detailed as follows:

a. Series I

(1) Migration:

The rate of out-migration is gradually scaled down from the 1940-55 level so that migration in 1970-75 should approximate only 75% of the 1940-55 level. It should be noted that all the states that lost population between 1950 and 1955 experienced relatively heavy out-migration between 1940 and 1955.

(2) Fertility:

The 1950-53 national level remains constant to 1970; births are projected on the basis of recent ratios of state birth rates to the U. S. rate.

(3) Mortality:

State mortality is tied in with the general level of mortality in the national population projection of October 20, 1955 (Series P-25, #123).

b. Series II

(1) Migration:

The 1930-55 migration level is assumed to apply at the beginning of the projection period; it is then scaled down so that, by 1970-75, migration levels approximate 75% of those in the base period.

(2) Fertility:

Same assumption as for Series I.

(3) Mortality:

Same assumption as for Series I.

c. Series III

(1) Migration:

Same assumption as for Series II.

(2) Fertility:

The 1950-53 rate declines linearly from 1953 to roughly the level of the 1940-42 rates at the end of the projection period.

(3) Mortality:

Same assumption as for Series I and II.

The three series are plotted in Figure 3, which also shows the official estimates of the population of Maine for each of the years since the 1950 census. Table XI breaks down these postcensal estimates into civilian and military components which show that Maine's modest growth since 1950 is almost wholly caused by the increase in armed forces stationed in the state. The 1955 population estimate, which is the point of departure for our projections, thus includes a military component that is assumed to remain stable through the projection period.

The year 1955 was chosen as the point of departure for the following reasons:

1. The 1955 estimate is a revised figure, whereas both 1956 and 1957 population estimates are based on provisional birth and death statistics. The Bureau of the Census further cautions that the estimates of net migration for the two most recent years are subject to considerable error, since they are obtained by extrapolation of earlier school-registration data. Finally, the Division of Vital Statistics of the Maine Department of Health and Welfare considers the provisional 1957 population estimate to be overstated.

2. With 1955 as a base year, bench marks that tie in with the economic forecasts in Part III could be established for 1960 and 1965.

FIGURE 3

Population Projections
Maine, 1955 - 1970

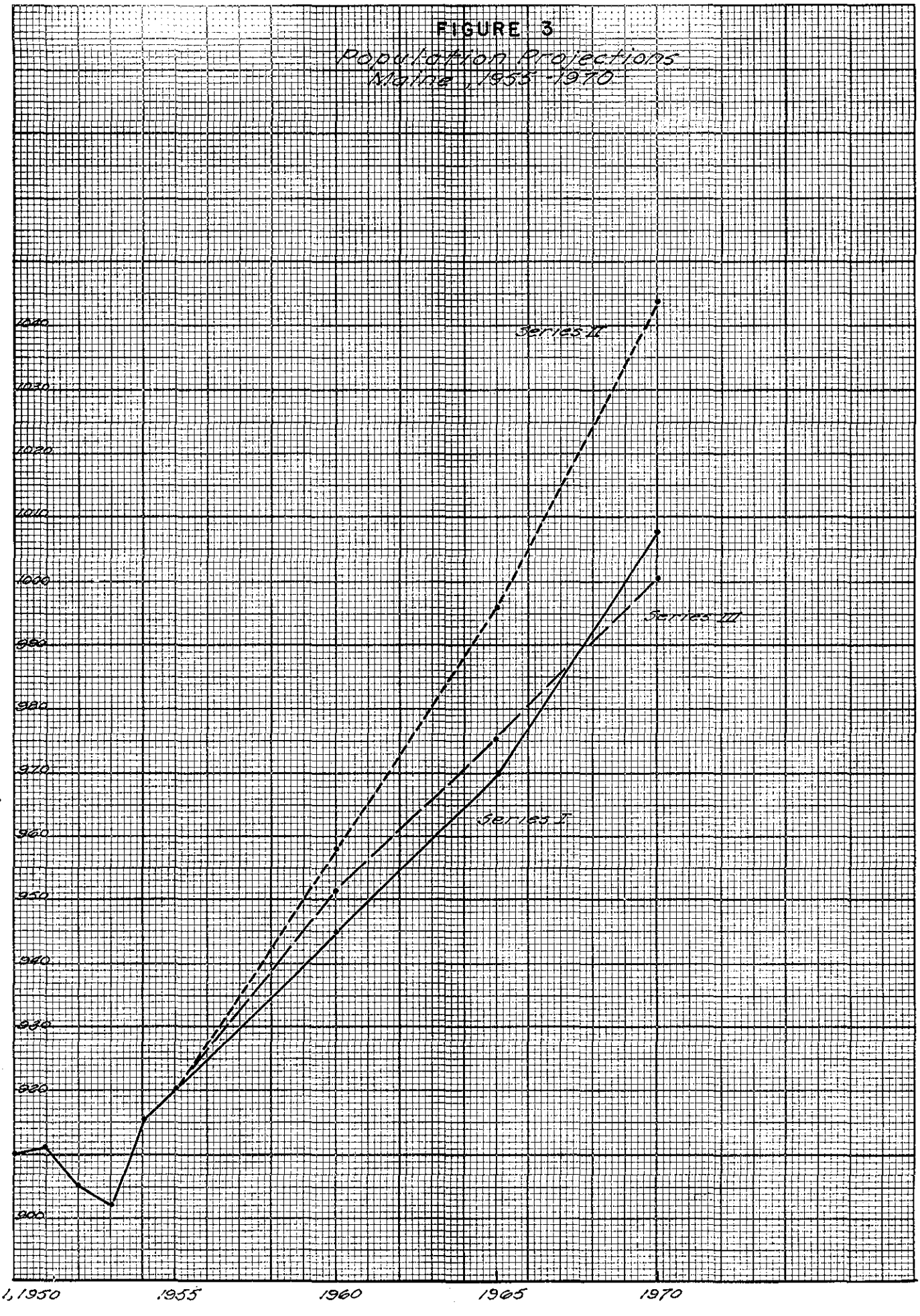


TABLE XI

INTERCENSAL ESTIMATES OF THE POPULATION OF MAINE BY CIVILIAN AND MILITARY COMPONENTS, 1950-57

	Total Population	Civilian Population	Armed Forces Stationed in State
April 1, 1950*	914,000	912,000	2,000
July 1, 1950	910,000	908,000	2,000
July 1, 1951	911,000	904,000	7,000
July 1, 1952	906,000	898,000	8,000
July 1, 1953	903,000	891,000	12,000
July 1, 1954	915,000	900,000	15,000
July 1, 1955	920,000	905,000	15,000
July 1, 1956	930,000	916,000	14,000
July 1, 1957	943,000	927,000	16,000

* Enumerated population, 1950 census.

Source: Bureau of the Census, Current Population Reports, Series P-25, No. 165, November 4, 1957; Series P-25, No. 168, December 9, 1957.

2. Selection of "Preferred" Projection

Of the three projections prepared for this report, Arthur D. Little, Inc., has selected Series I because it reflects the most realistic combination of components of population change. Our choice is supported by the following agreement.

Mortality has been held constant at the 1956 level in all three projection series.

For the fertility component, we have made two assumptions: (a) maintenance of 1950-53 age-specific fertility rates to 1970 for Series I and II; and (b) a slowly declining fertility rate for Series III. Fertility rates are subject to unpredictable short-term variations often ascribed to economic fluctuations. However, barring a major economic downturn, all the statistical indicators (marriage rate, age at marriage, order of births, etc.) point to a continuation of the high birth rate of the early 1950's. It is on this basis that we have eliminated Series III from consideration.

The choice between Series I and II narrows down to the assumptions on which the migration component is projected. The following tabulation shows that the difference in net migration between these two series is proportionately larger than the difference in the number of births between Series I and III:

	Series I	Series II	Series III
Projected number of births, 1955-70	319,000	323,000	279,000
Projected net migration, 1955-70	-77,000	-44,000	-44,000

Series II assumes that migration will continue at the rate that prevailed during 1930-55. The decade of the Great Depression caused a reversal in the long-term trend of out-migration from Maine; this is clearly shown by the decennial comparisons of Table VI. Hence, we feel that a projection using the years 1930-55 as a base presents an unduly favorable trend of future migration, given the record of the past 85 years. This favorable trend is further "sweetened" by the fact that the rate of out-migration is scaled down toward the end of the projection period, as postulated in both assumptions. Short of an unforeseeable influx of military personnel and their dependents or of a major shift in the state's economic structure, there is no reason to believe that the future course of migration will be any more favorable than that assumed for Series I (continuation of the 1940-55 rate, with progressive scaling down of out-migration towards the end of projection period). Series I thus emerges as our choice for use in the economic projections elsewhere in this report.

III. EMPLOYMENT, PERSONAL INCOME, AND BUSINESS FLUCTUATIONS

Manufacturing provides a higher proportion of employment and personal income in Maine than in the United States as a whole; its lack of diversity and the importance of a small group of industries that are particularly sensitive to changes in business activity have recently caused Maine to become a leading index of national recession.

A. EMPLOYMENT AND WAGES

The importance of manufacturing employment to Maine's economy is shown in Table XII. Of total nonfarm employment of 281,700 in 1956, 39% was in manufacturing; 12% of this group was in durable goods and 27% in nondurable. This percentage in manufacturing is higher than that of the United States (32%), even though in the country as a whole, durable goods are more important (19%) than they are in Maine.

Essentially the same information on sources of employment is presented in Table XIII, which utilizes data of the 1950 census for Maine and the United States and lists percentages within the major categories.

The average hourly wage rate in manufacturing in Maine is less than the national average. In 1955, the average rate for the country was $1.88; in Maine it was $1.45, or 77% of the U. S. figure. The discrepancy between U. S. and Maine wages has tended to become greater in the past few years. In 1948, Maine's wage ($1.16 per hour) was about 86% of the U. S. average ($1.35). The differences in hourly earnings are also carried over into average weekly wages. (See Tables XIV and XV.)

B. PERSONAL INCOME

Since 1929, personal income has increased by 217% in comparison with an increase of 200% in New England and 279% in the United States as a whole.

In 1929, the most important sources of personal income within the state, in order of magnitude, were: property income (i.e., dividend payments, rental income, and personal interest income); manufacturing income (primarily wages and salaries); farm income; and nonfarm proprietors' income. By 1955, manufacturing had become by far the most important source of income; property income was the second most important

source, followed by nonfarm proprietors' income and finally farm income. Equally important as the growth in manufacturing income and the relative decline in property income has been the spectacular rise in income generated by the federal, state, and local governments and transfer payments.

Total personal income earned in Maine for 1956 was $1,517 million. The major part (65%) was received through wage and salary disbursements, a slightly lower percentage for this source than is true for either the United States (69%) or New England (71%). Proprietors' income and property income both accounted for a slightly higher proportion than that of the rest of the country. (See Table XVI.)

The industrial sources (not including property income) of personal income in Maine are shown in Table XVII, which indicates that manufacturing accounts for 34% of the income, a higher percentage than that of the United States (31%). Farm income is more important to Maine than to either the United States or New England. Services, on the other hand, provide less income (9%) in Maine than in the rest of the country.

Strong differences in personal income are revealed in county statistics. In 1950, the median income for families and unrelated people in Maine was $2213. The spread among the 16 counties, however, ranged from a median of $1482 in Waldo County to $2520 in Androscoggin County.

As shown in Table XVIII and Figure 4, the median income of the four counties in the southwest--York, Cumberland, Androscoggin, and Kennebec--was above the state's median. The contiguous county of Oxford was 1% above the state average. Higher income is concentrated in the southwestern portion of the state largely because most of the manufacturing is located in those counties. Waldo, Hancock, and Washington Counties fall below the state median income by 33%, 20%, and 28%, respectively. Industrial activity in these counties is primarily food processing, which provides only seasonal and irregular employment.

C. BUSINESS FLUCTUATIONS IN MAINE

Economic fluctuations in Maine conform to the general pattern of the United States, though with their own peculiarities. The similarities between Maine business conditions and those of the United States are evident from the Chart of Maine Earnings in Manufacturing and U. S. Factory Payrolls. (See Figure 5.) A more inclusive index of fluctuations in the Maine economy is provided by the Maine Business Index, which has been developed by the Maine Community College Research Program. (See Figure 6.)

TABLE XII

NONFARM EMPLOYMENT IN MAINE, 1956

Monthly Averages - Maine and the United States

Percentage Distribution of Selected Components

	Maine		United States
	(thousands)	(percent)	(percent)
Total Nonfarm	281.7	100	100
Total Manufacturing	110.1	39	32
Durable	35.2	12	19
Nondurable	74.9	27	14
Lumber and Wood	21.0	7	1
Textile	17.8	6	2
Paper	18.6	7	1
Leather	20.6	7	1
Total Nonmanufacturing	171.6	61	67
Wholesale and Retail Trade	56.5	20	21
Government	44.1	16	14

Sources: Maine Employment Security Commission, and Bureau of Labor statistics.

TABLE XIII

MAJOR INDUSTRY GROUP OF EMPLOYED PERSONS IN THE UNITED STATES AND MAINE, 1950

(Percentages are of Total Employment)

Industry Grouping	United States	Maine
Agriculture, Forestry, Fisheries	12.5%	11.1%
Mining	1.7	0.2
Construction	6.1	5.4
Manufacturing	25.9	34.2
Transportation, Communication, and Other Public Utilities	7.8	7.3
Wholesale and Retail Trade	18.7	16.8
Finance, Insurance, Real Estate	3.4	2.2
Business and Repair Services	2.5	2.6
Personal Services	6.2	5.9
Entertainment and Recreation Services	1.0	0.7
Professional and Related Services	8.3	8.1
Public Administration	4.4	3.9
Industry Not Reported	1.5	1.6
	100.0%	100.0%

Source: U. S. Bureau of the Census.

TABLE XIV

AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS IN MANUFACTURING IN MAINE AND THE UNITED STATES, 1948-1955

Year	United States	Maine	Maine as Percent of United States	Differential*
1948	$1.35	$1.16	85.9%	$0.19
1949	1.40	1.15	82.1	0.25
1950	1.47	1.19	81.0	0.28
1951	1.59	1.31	82.4	0.28
1952	1.67	1.35	80.8	0.32
1953	1.77	1.40	79.1	0.37
1954	1.81	1.42	78.5	0.39
1955	1.88	1.45	77.1	0.43

* Excess of U. S. earnings over Maine earnings.

Source: Statistical Abstract of the U. S., and Maine Employment Security Commission.

TABLE XV

AVERAGE WEEKLY EARNINGS OF PRODUCTION WORKERS IN MANUFACTURING IN MAINE AND THE UNITED STATES, 1948-1955

Year	United States	Maine	Maine as Percent of United States	Differential*
1948	$54.14	$47.55	87.8%	$ 6.59
1949	54.92	45.81	83.4	9.11
1950	59.33	48.93	82.5	10.40
1951	64.71	52.44	81.0	12.27
1952	67.97	55.17	81.2	12.80
1953	71.69	56.88	79.3	14.81
1954	71.86	56.52	78.7	15.34
1955	76.52	58.98	77.1	17.54

* Excess of U. S. earnings over Maine earnings.

Source: Statistical Abstract of the U. S., and Maine Employment Security Commission.

TABLE XVI

PERSONAL INCOME BY MAJOR SOURCES, 1956

(Selected Components)

	Maine		New England	United States
	Millions of Dollars	Percent Distribution	Percent Distribution	Percent Distribution
Personal Income	1517	100%	100%	100%
Wage and Salary Disbursements	994	65	70	69
Manufacturing	389	26	30	24
Wholesale and Retail Trade	163	11	12	12
Services	74	5	7	6
Government	172	11	9	11
Other Labor Income	26	2	2	2
Proprietors' Income	214	14	8	12
Property Income	197	13	15	12
Transfer Payments	111	7	6	6

Source: Survey of Current Business, August, 1957.

TABLE XVII

INDUSTRIAL SOURCES OF CIVILIAN INCOME

(Percentage Distribution of Selected Components)

	Maine	New England	United States
Total	100%	100%	100%
Farm	8	2	5
Contract Construction	6	6	6
Manufacturing	34	40	31
Wholesale and Retail Trade	20	19	20
Services	9	12	11
Government	10	9	11

Source: Survey of Current Business, August, 1957.

TABLE XVIII

MEDIAN INCOME, 1950, BY COUNTIES

(Families and Unrelated Individuals)

State of Maine	$2213	
County		Percent Above or Below State Median
Androscoggin	$2520	+14%
Aroostook	2106	- 5
Cumberland	2476	+12
Franklin	1986	-10
Hancock	1767	-20
Kennebec	2380	+ 8
Knox	1870	-15
Lincoln	1662	-25
Oxford	2236	+ 1
Penobscot	2146	- 3
Piscataquis	2113	- 5
Sagadahoc	2187	- 1
Somerset	2048	- 7
Waldo	1482	-33
Washington	1593	-28
York	2464	+11

Source: Bureau of the Census.

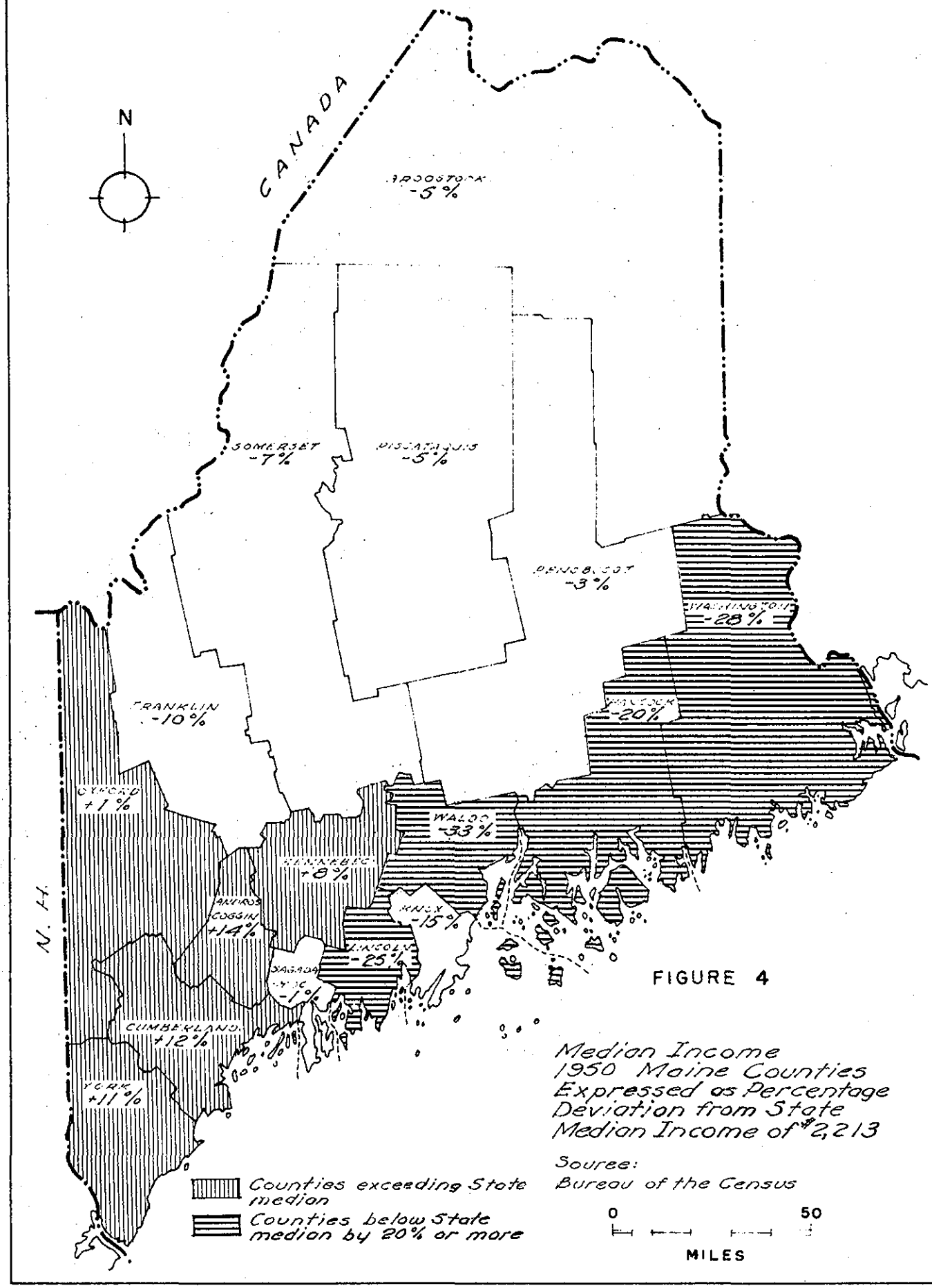


FIGURE 4

Median Income
1950 Maine Counties
Expressed as Percentage
Deviation from State
Median Income of $2,213

Source:
Bureau of the Census

FIGURE 5

Maine Earnings in Manufacturing
U.S. Factory Payrolls

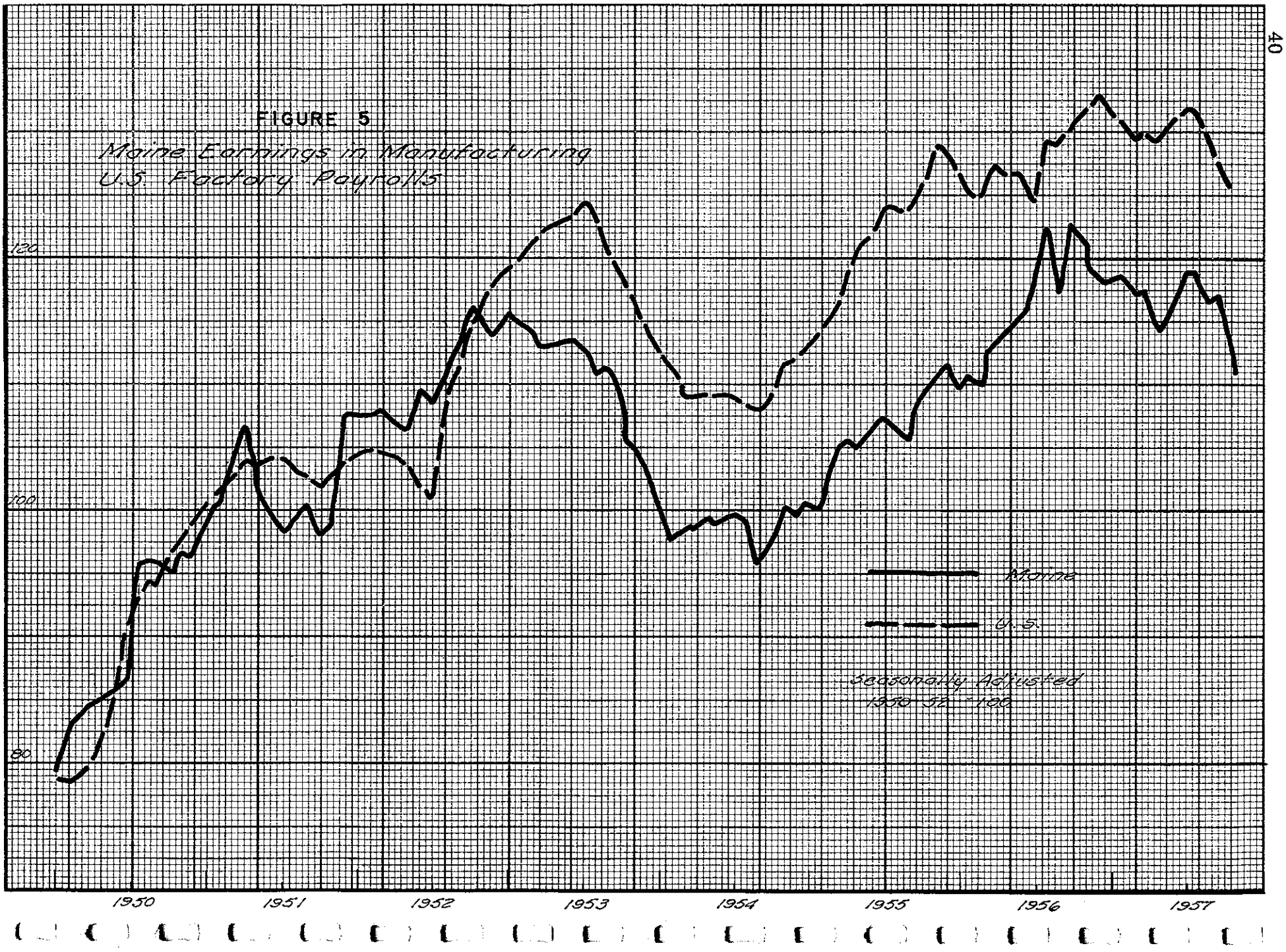
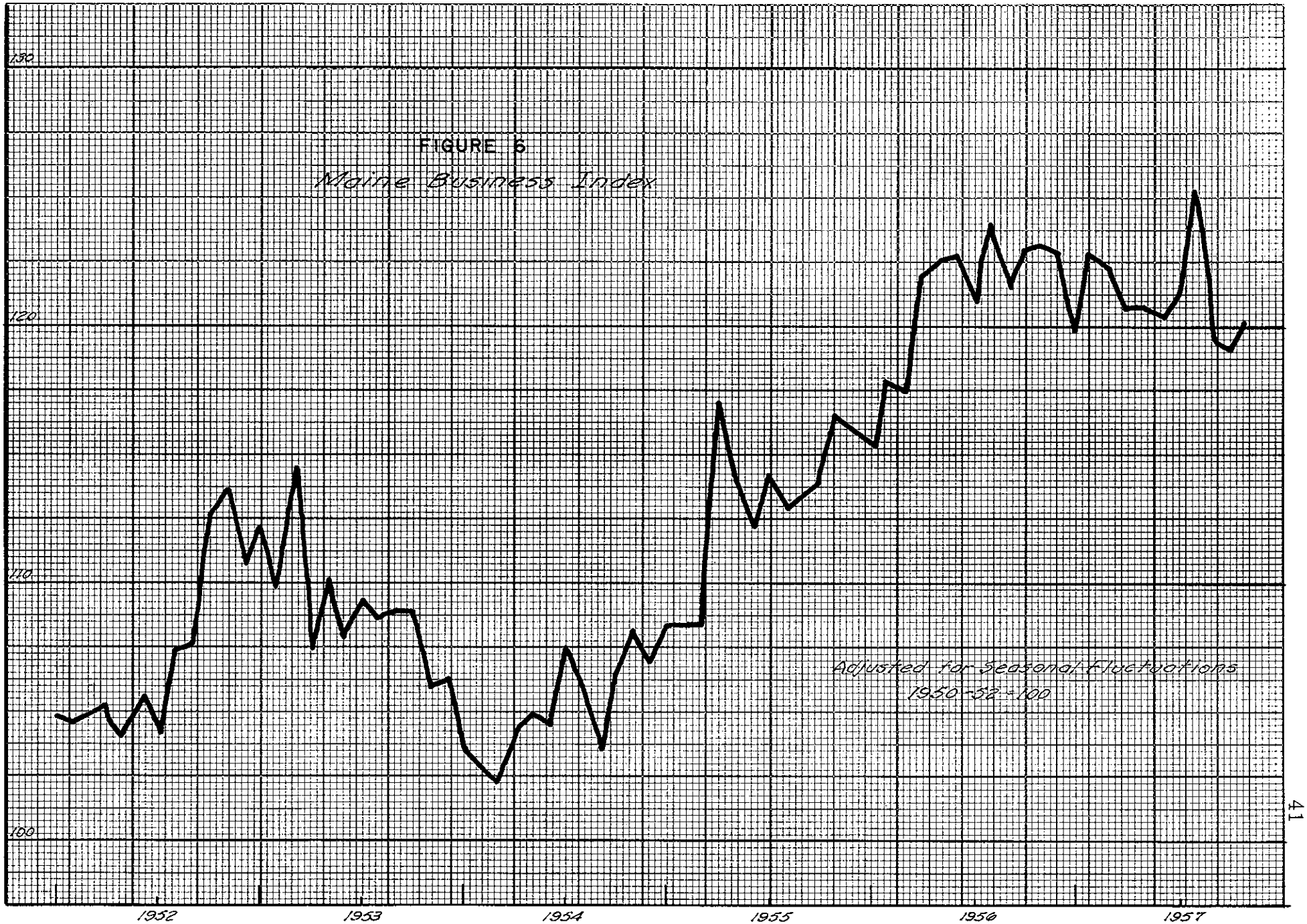


FIGURE 6

Maine Business Index



Comparison of state and national data indicates that Maine business tends to lead the country in a downturn. According to the National Bureau of Economic Research, in the recession of 1953-54, the turning point in U. S. business activity was in July, 1953. The Maine Business Index reached its peak earlier, in March of that year. Subsequently, the National Bureau recorded a peak in July, 1957, but growth in Maine stopped by mid-1956, and the Maine economy drifted along until early in 1957, when a decline began.

The same pattern is evident in the sensitive area of construction employment. In the first quarter of 1957, Maine employment was about the same as it was in the first quarter of 1956. For the United States, however, the first quarter of 1957 employment was above 1956 levels. By the second quarter of 1957, Maine had dropped below 1956 levels, while the United States remained constant. By the third quarter, construction employment in Maine was 6% below 1956, while in the United States, it was less than 1% below the same quarter of the preceding year. In the first nine months of 1957, the value of building permits in Maine had declined by 12% from the 1956 level; for the United States, the value had dropped by only 4%.

Fluctuations in Maine are strongly influenced by variations in the manufacturing sector. Of total nonagricultural employment, 37% is in manufacturing in Maine; the comparable figure for the United States is 32%. Within manufacturing, Maine produces few durable goods; 12.4% of manufacturing employees are in the category, compared with 19% nationally. Because the durable-goods sector normally experiences a recession earlier and more acutely, it might be concluded that Maine would suffer relatively less in any recession. However, the absence of heavy industry in the state is more than offset by the conditions existing in the state's few important manufacturing industries. Four industries--textiles, leather and shoes, paper and lumber, and wood products--account for over 70% of Maine's manufacturing employment. There do not appear to be any strong buoyant or growth factors within these four industries.

D. EMPLOYMENT AND INCOME IN WASHINGTON COUNTY

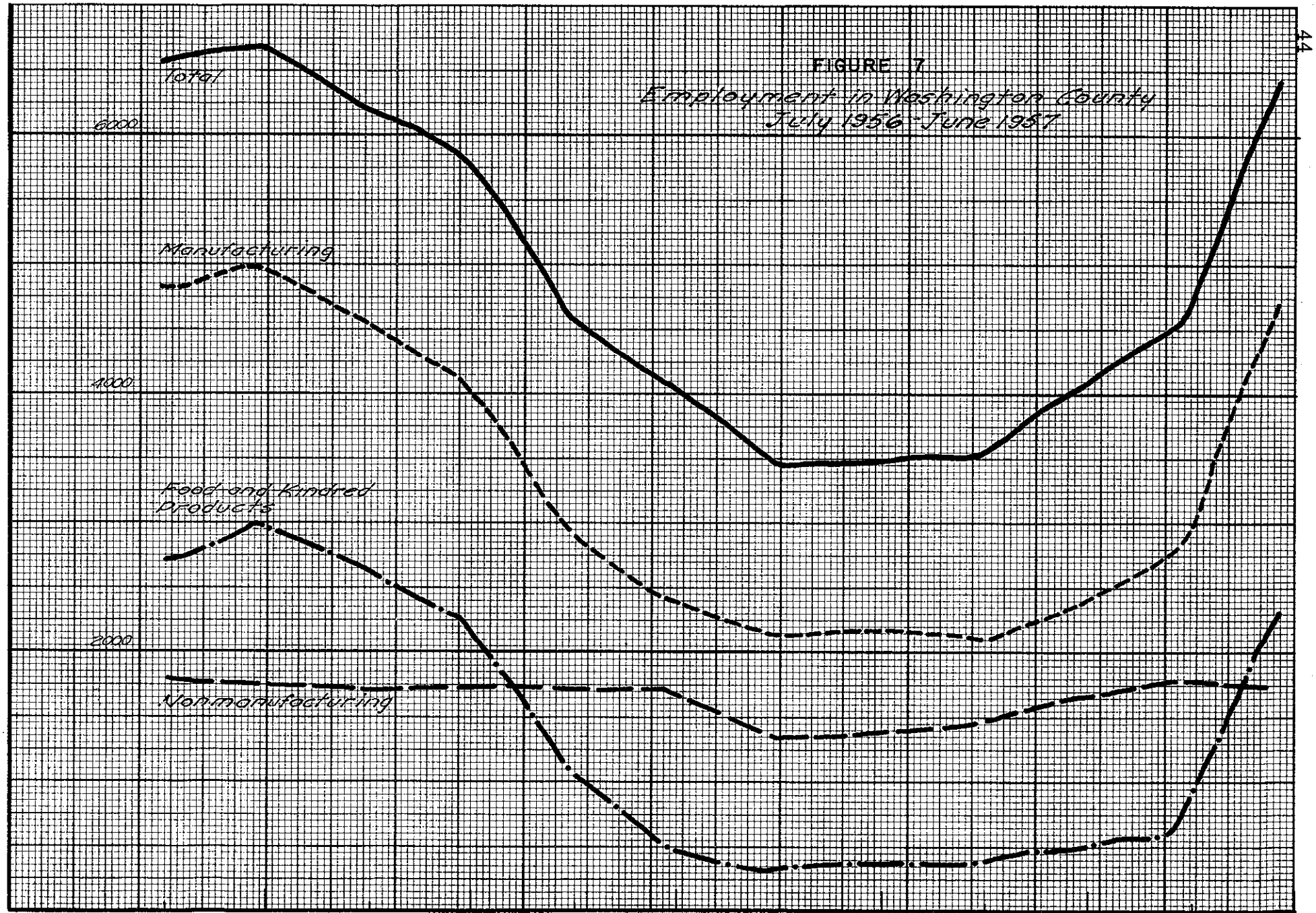
Income data on an annual basis for Washington County is not available, but it is possible to obtain an estimate of the differences between the county and the state. In Washington County, 60% of population was estimated to have an income of less than $2000; for the state as a whole, only 45% of the population was in this low-income group.

More recent information, although not as comprehensive, is available in the State Census of Maine Manufactures. In 1956, the gross average annual wage for those engaged in manufacturing was $2805 in the county, compared with $3413 for the state. The county wage is strongly influenced by the preponderance of employment in food processing, particularly in sardine canning and blueberry packing. It has been pointed out elsewhere in this report that employment in the sardine canneries is highly seasonal and that women comprise 60% of the work force. The relative importance of this labor in the food-processing industries is shown in Figure 7, which shows total nonagricultural as well as the manufacturing, food-processing, and nonmanufacturing employment in Washington County for a 12-month period.

The county's unemployment problem was acute in 1958. The Maine Employment Security Commission in Calais believes that normal unemployment in January is 2000, dropping to as low as 50 in August. In January, 1958, unemployment in the county is estimated to have run as high as 3500, with over 2500 being registered in the Calais office alone.

FIGURE 7

Employment in Washington County
July 1956 - June 1957



IV. AGRICULTURE

A. GENERAL CHARACTERISTICS AND RECENT TRENDS

Agriculture provides 6-8% of total personal income in Maine. However, there are occasional years in which the contribution of agriculture either exceeds or falls short of that range as a result of extreme fluctuations in potato prices. As one might expect, farm income is more important to Maine than to either New England or the United States as a whole.

In the past, Maine agriculture has been dominated by the potato crop. Prices for this crop have varied widely from year to year as a result of variations in the size of the harvest throughout the country and the relative inelasticity in demand for potatoes. In the face of rising output in other parts of the United States, Maine has maintained its position as the leading potato-producing state because of great increases in yields on a reduced acreage. These improvements in the efficiency of potato growing have recently been backed up by innovations in packaging, marketing, and processing that reflect the consumer's growing demand for services.

One of the most encouraging developments in Maine agriculture has been that poultry and poultry products recently displaced potatoes as the primary source of farm income. In 1955, the sale of broilers, eggs, chickens, and turkeys brought Maine farmers 37% of their cash receipts. Maine has become the only New England state where three major products contribute the bulk of farm income. (See Table XIX.) Because of the spectacular success of Maine broilers in the New York and Boston metropolitan markets, the state has succeeded, through agricultural diversification, in reducing the impact of fluctuating potato prices.

The shift from subsistence to commercial farming which occurred throughout New England during the last generation has taken place somewhat more slowly in Maine. In 1954, 56.5% of all Maine farms were classed as commercial, while 61.6% of New England farms were thus categorized. The transition to more commercial farming has resulted in substantial increases in the average size of farms and the value of land and buildings, and in a corresponding decline in the total number of farms and the proportion of the state's land remaining in farms. (See Table XX.) The acreage of a farm is only one indication of its size. A better measure is the value of products sold. In 1954, 50% of Maine's commercial farms sold products valued in excess of $5000, while only 39% of all U. S. commercial farms had sales of $5000 or more. The decline in agricultural employment, which has paralleled the national decrease in the farm labor force, reflects the spurt in agricultural productivity resulting from the rapid adoption of new technology.

TABLE XIX

CASH RECEIPTS FROM MARKETING OF FARM PRODUCTS AS A PERCENTAGE OF TOTAL FARM MARKETING IN STATE, 1955

	New England	Maine	New Hampshire	Vermont	Massa-chusetts	Rhode Island	Connecticut
Total	100	100	100	100	100	100	100
Dairy	35.4	20.5	34.4	76.1	31.2	44.3	28.6
Poultry	32.1	37.0	46.8	10.6	32.7	26.2	35.1
Potatoes	8.6	29.4	1.9	0.8	1.1	6.9	2.2
Tobacco	4.6	--	--	--	5.1	--	14.4
Truck Crops	4.0	2.6	3.9	0.7	7.3	6.2	4.2
Fruit	3.8	2.6	4.1	2.1	6.8	2.7	3.0
Greenhouse and Nursery	5.7	1.2	2.1	0.4	9.9	10.9	10.2
All Other	5.8	6.7	6.8	9.3	5.9	2.8	2.3

Source: U.S.D.A., Agricultural Marketing Service.

TABLE XX

STATISTICS OF MAINE AGRICULTURE, 1920-1954

(percent)

	1920 (January)	1930 (April)	1940 (April)	1945 (January)	1950 (April)	1954 (October)	% Change 1920-1954
Proportion of state's land in farms	28.0	24.3	21.3	23.2	21.0	18.2	-36
Land in farms (million acres)	5.4	4.6	4.2	4.4	4.2	3.6	-33
Number of farms	48,200	39,000	39,000	42,184	30,400	23,400	-52
Percentage change from previous census year	--	-19	--	+8	-28	-23	
Average size of farms (acres)	112	119	108	109	137	155	+38
Percentage change from previous census year	--	+6	-10	+1	+26	+13	
Value of land and buildings ($)							
Average per farm	4,232	4,981	3,183	3,785	7,570	9,330	+120
Average per acre	38	42	29	35	54	61	+61
Dairy products sold (M$)	15,500	12,500	9,100	16,800	22,100	24,300	+57
Poultry and poultry products sold (M$)	N.A.	N.A.	5,700	13,400	26,200	41,100	+621
Irish potatoes, value (M$)	52,300	56,000	24,400	65,700	65,700	53,000	+1
Number of agricultural workers	61,300	51,500	39,200	N.A.	29,400	N.A.	-52*

* Percentage change, 1920-1950.

Source: Bureau of the Census; Population Redistribution and Economic Growth, U. S., 1870-1950, Vol. I, American Philosophical Society, Philadelphia, 1957, p. 613.

B. OUTLOOK FOR MAINE'S PRINCIPAL PRODUCTS

1. Potatoes

The potato industry in the United States has been passing through a revolutionary period of readjustment.* During the past 20 years, the industry has experienced a period of Government price control, adjustments to lower per-capita consumption, the introduction of new potato products, and many changes in handling and merchandising.

U. S. per-capita consumption of potatoes declined from 195 pounds in 1910 to about 100 pounds in 1956. It appears that the decline has been at least temporarily arrested as a result of the expansion of processed items and the introduction of new marketing techniques.

The U. S. potato crop is now grown on less than one-half the acreage reported in 1921-25. Since the quantity of potatoes produced in the two periods was approximately the same, nationwide yields per acre have doubled. Maine has been able to keep its position as the nation's ranking potato-growing state (see Table XXI) by maintaining its lead in the race for higher yields. Maine's yields have risen from 250 bushels per acre in 1921-25 (when the national average was less than 100 bushels per acre) to an average of 380 bushels in 1951-55. Only California's early potato growers have been able to achieve higher yields. (See Table XXII.)

The high level and great increase in Maine's potato yields have been the result of improved seed, the development of higher-yielding varieties, the increased use of fertilizer, and improved techniques to control insects and disease. During the early postwar years, the average allotments in connection with the price-support program provided a strong impetus for higher yields per acre. Facing a curtailment of acreage, producers withdrew their lowest-yielding land from production and used more intensive practices on the remaining acres. Although yields declined somewhat after the price-support program was discontinued at the end of the 1950 crop season, Aroostook County farmers have maintained their intensive practices on the acreage kept in potatoes and have converted the remaining acres into pasture for an expanded dairying industry.

*The discussion of changes in the potato industry is based on Charles H. Merchant and Allen G. Waller, "Shifts and Trends in the Potato Industry," Maine Agricultural Experiment Station Bulletin 566, November, 1957.

TABLE XXI

POTATO PRODUCTION IN THE LEADING GROWING STATES
BY FIVE-YEAR AVERAGES, 1921-1955
(Thousand Bushels)

State and Region	1921-25	1926-30	1931-35	1936-40	1941-45	1946-50	1951-55
Maine	33,361	40,736	44,897	41,844	53,301	70,464	54,354
Idaho	12,879	20,074	23,576	28,363	37,456	41,169	43,662
New York	32,723	25,692	31,748	27,112	29,752	36,613	30,149
California Early	--	667	3,244	9,192	16,840	30,378	27,188
California Late	9,161	7,261	6,061	9,622	11,524	14,032	15,849
United States	375,535	359,142	377,518	355,109	397,362	431,689	357,471

Source: "Shifts and Trends in the Potato Industry in the Northeastern United States," Maine Agricultural Experiment Station Bulletin 566, November, 1957, p. 33.

TABLE XXII

YIELD IN BUSHELS PER ACRE OF POTATOES BY FIVE-YEAR AVERAGES OF SELECTED STATES AND REGIONS, 1921-1955

State and Region	1921-25	1926-30	1931-35	1936-40	1941-45	1946-50	1951-55
Maine	249	254	269	266	291	398	379
Nine Eastern States	133	145	157	161	184	291	308
Nine Central States	92	92	81	88	101	151	186
Idaho	186	209	203	230	229	267	295
California Early	--	159	213	304	324	414	426
Thirteen Early States (including California)	78	85	85	98	110	174	216

Source: Charles H. Merchant and Allen G. Waller, "Shifts and Trends in the Potato Industry in the Northeastern United States," Maine Agricultural Experiment Station Bulletin 566, November, 1957, p. 39.

Several important changes have been taking place in the marketing of the potato crop. Washed potatoes are now being shipped from many sections of the country. A few Maine shippers began washing potatoes in 1952; by 1956, 20% of the crop was washed. The washed potato has been so successful that it may soon be difficult to find unwashed potatoes at grocery stores. Furthermore, an increasing quantity of potatoes is leaving production areas in consumer packages, including polyethylene bags. This change from wholesale packages coincides with the requirements of modern self-service grocery stores. Maine has been in the forefront in making these changes.

Although freight rates for the nation have advanced rapidly since 1947, the comparative relationship of rates between important producing areas has remained nearly constant. Truck transportation has become increasingly important, especially for Maine potato producers, who are located near their markets.

Trends in potato utilization have changed drastically in the last several decades. As recently as 1940, only 67% of the crop was sold commercially; in the last five seasons, on the other hand, commercial sales have averaged 84% of the crop. This is due to the fact that less seed is needed now because a smaller acreage of potatoes is planted and a smaller proportion of the crop is used on the farm. While this trend has had a significant effect upon the annual quantity of potatoes offered for sale and hence upon the price paid to farmers, the future rate of change in potato utilization cannot be expected to be as rapid as it was in the past 10-15 years.

Recent developments in processing are of even greater importance to the potato industry. In 1940, processors purchased one out of every 50 bushels sold by growers; in 1956, they purchased one out of every five. Most of these potatoes were processed into chips, but frozen french fries and other prepared frozen foods account for an increasing share of processors' requirements. Moreover, the Agricultural Marketing Service has introduced potato flakes--a new form of dehydrated mashed potatoes--in the expectation that such a convenient household product would expand markets and extend the marketing season for potatoes.*

As stated earlier, potato prices fluctuate violently because of the wide year-to-year variation in the size of the nation's crop. These fluctuations are the principal cause of instability in Maine farmers' realized net income (see Table XXIII), because cash receipts from other farm

*Potato Flakes, Marketing Research Report No. 186, 1957.

TABLE XXIII

REALIZED GROSS INCOME AND NET INCOME OF FARM OPERATORS, 1950-1956
(Millions of Dollars)

	1950	1951	1952	1953	1954	1955	1956
Cash receipts from farm markets	166.1	184.6	212.6	171.0	140.7	179.2	179.9
Total farm income[1]	188.4	207.6	236.7	195.0	161.2	199.6	201.9
Less farm production expenses	124.1	137.6	141.0	138.3	133.5	134.3	143.0
Total net farm income[2]	68.4	62.9	107.5	63.7	21.7	72.6	67.7

1. Includes Government payments, value of home consumption, gross rental value of farm dwellings.

2. Includes net change in farm inventories.

Source: United States Department of Agriculture, Agricultural Marketing Service.

marketings are not subject to such variations. It is, therefore, safe to predict that the potato's relative decline in the "mix" of farm products sold in Maine will tend to stabilize annual receipts from marketings on a state-wide basis.

Maine potato growers are showing increasing concern about improved methods of handling and marketing their crop, and the growing demand for processed and frozen products is likely to outweigh any further declines in U. S. per-capita potato consumption. With rising standards of living, the shift toward convenience foods offers new opportunities for the establishment of potato-processing facilities between the growing areas and the large metropolitan markets of the Northeast. Hence, no decline in the average value of Maine's potato crop is anticipated.

2. Poultry

Because of the spectacular postwar increases in broiler production, poultry raising has displaced potatoes as the chief source of agricultural income in Maine. Table XXIV shows how the sharp growth in commercial broiler production has been accompanied by substantial reductions in unit price and by steady increases in farmers' gross income. Maine broilers have successfully invaded the Boston and New York metropolitan markets (see Table XXV), and have stimulated a profitable poultry-dressing industry within the state.

While registering these gains, broiler producers have greatly increased the efficiency of turning feed into chicken meat (a 50% increase between 1940 and 1956); hence, unit costs have been reduced. Passed on to the ultimate consumer, these lower costs, in turn, have been partially responsible for the 75% increase in nationwide per-capita consumption of chicken meat in the past 20 years. Broilers represent an ever-growing proportion of this consumption. (See Table XXVI.)

Finally, because the expansion of broiler production in Maine has not been accompanied by similar increases in other New England states, Maine has captured the region's metropolitan markets. (See Table XXVII.)

It is difficult to predict the future of an agricultural product whose output and markets have expanded spectacularly without severe competition from other producing areas. However, it is safe to assume that in view of the processors' heavy investment in plant and equipment, Maine poultry farmers will continue to find a ready market for their broilers, particularly those in the principal producing areas--Waldo and Kennebec Counties. But even the most optimistic predictions do not envision a rate of growth similar

to the 100% increase in Maine broiler production between 1952 and 1957. Having captured more than 70% of the total market, the broiler industry is much nearer the saturation point than it was in 1952, when it constituted only 50% of chicken consumption. An annual increase of 10% in broiler production can be conservatively predicted for Maine on the basis of: (a) population growth in the metropolitan areas of the Northeast, (b) a widening market beyond the 500-mile range,* and (c) a continued upswing in U. S. per-capita consumption of chicken meat. This increase in broiler production should offset (in terms of cash receipts from poultry marketings) the indicated decline in egg production and demand.**

3. Dairy Products

Maine dairy farmers primarily sell fresh whole milk to dairies for direct human consumption; only a small part of the output is sold to manufacturers of butter, cheese, and other processed dairy foods. On a nationwide scale, the supply of milk has exceeded commercial use by 4 or 5% for at least six years. Abundant supplies of feed concentrates have contributed to record levels of milk output. With heavier feeding rates and generally better herd management (including the greatly expanded use of artificial insemination), output per milk cow continues to set new records in all the principal dairy regions. However, Maine's output per milk cow is still among the lowest in the North Atlantic area. (See Table XXVIII.) Nevertheless, the increase in output per animal more than offsets the long-term downtrend in the number of milk cows on farms.

Milk prices paid to farmers have shown slight increases in each of the last three years, and they are now favorable relative to feed costs. This is important because Maine dairy farmers purchase a sizable share of their concentrates from the Corn Belt.

---

* According to a study of interstate trucking of fresh and frozen poultry (Marketing Research Report No. 224, 1958, U. S. Department of Agriculture), the market area for fresh poultry has broadened substantially in the past five years. In 1952, 82% of total U. S. volume of fresh poultry was marketed within 500 miles of processors' plants; only 68% was marketed within this radius in 1956-57.

** United States Department of Agriculture, Agricultural Marketing Service, Agricultural Outlook Charts.

TABLE XXIV

STATISTICS OF COMMERCIAL BROILER PRODUCTION IN MAINE, 1947-1957

Year	Number of Broilers Produced (thousands)	Price Per Pound (cents)	Gross Income (thousands of dollars)
1957	50,524	19.5	37,364
1956	43,469	19.3	30,202
1955	33,438	24.4	29,372
1954	30,677	22.5	24,848
1953	27,888	25.9	27,447
1952	23,048	27.0	23,647
1951	21,145	27.6	23,928
1950	16,916	27.5	20,468
1949	13,012	27.3	14,919
1948	6,506	35.0	9,108
1947	2,299	29.0	2,667

Source: United States Department of Agriculture, Agricultural Marketing Service.

TABLE XXV

POULTRY RECEIPTS AT BOSTON AND NEW YORK CITY, BY STATE OF ORIGIN

	Percentage Distribution by State of Origin		
	1956	1955	1952
Boston:			
Maine	27	30	11
Maryland	6	7	3
Massachusetts	14	18	26
New York City:			
Maine	20	19	15
Maryland	17	19	7
Delaware	14	13	27

Note: In the Boston market, Maine has become the foremost supplier, largely at the expense of Massachusetts. Similarly, in New York City, Maine has displaced Delaware as the largest supplier; however, in the New York market, Maine is meeting strong competition from the Delaware Peninsula.

Source: United States Department of Agriculture, Agricultural Marketing Service, Marketing Research Report No. 224, 1958.

TABLE XXVI

PER-CAPITA CONSUMPTION OF CHICKEN MEAT (READY-TO-COOK), 1940-1956

Year	Weight (lb)	Approximate Percentage Which is Specialized Broilers
1940	14.1	14
1941	15.4	18
1942	17.7	18
1943	23.0	18
1944	20.4	19
1945	21.6	23
1946	19.4	21
1947	18.1	24
1948	18.3	30
1949	19.6	36
1950	20.6	42
1951	21.7	48
1952	22.1	53
1953	21.9	56
1954	22.8	60
1955	21.4	64
1956	24.3	71

Source: United States Department of Agriculture, Agricultural Outlook Charts 1958.

TABLE XXVII

COMMERCIAL BROILER PRODUCTION, 1955-1957
(In Thousands)

State	1955	1956	1957
Maine	33, 438	43, 469	50, 424
New Hampshire	7, 627	8, 390	7, 635
Vermont	966	918	835
Massachusetts	17, 071	18, 437	14, 565
Rhode Island	1, 375	1, 581	1, 360
Connecticut	25, 852	30, 505	28, 370
New England	86, 329	103, 300	103, 189

Source: United States Department of Agriculture, Agricultural Marketing Service.

TABLE XXVIII

MILK PRODUCTION PER COW
(In Pounds)

	Average 1946-55	1956	1957*
Maine	5,627	6,150	6,410
New Jersey	7,390	7,910	7,950
Average, 9 North Atlantic States	6,416	7,052	7,092

*Preliminary

Source: United States Department of Agriculture, Agricultural Marketing Service, February, 1958.

Per-capita consumption of fluid milk and cream has changed very little in the postwar period. Hence, future demand is primarily a function of population growth. Although we have projected only a modest population increase for the state, Maine dairy farmers are likely to find a growing market in the metropolitan areas of nearby states. Moreover, important intraregional changes are taking place in New England. The owners of small herds and small farms are finding it difficult to modernize field and barn operations; as a result, they are going out of business. Many dairy farmers in southern New England are selling their land to real estate developers along the fringe of the urban belt as rising land values (and tax assessments) cause farm operations to become uneconomical. While southern New England loses its farmland to encroaching urban developments, it has been recognized that northern Maine--notably Aroostook County, which was once almost exclusively a potato-growing area--has many advantages for dairying, including the best summer pasture conditions in the East.* We may conclude, therefore, that Maine dairy farmers, by further reducing feed costs through the use of more and improved homegrown feed, are in a good position to raise their incomes from the sale of dairy products. Disregarding price-support purchases, the demand for the state's milk output may be expected to increase at an annual rate of 1-2%.

* Edward Higbee, American Agriculture, 1958; "Dairying in Aroostook County Potato Farms," Maine Extension Bulletin 415, October, 1951.

The general outlook for Maine agriculture may thus be described as mildly favorable. Annual fluctuations in farm income are likely to continue, but with somewhat reduced violence. Output will be further concentrated on large and efficient farms, while marginal and subsistence farms continue their rapid decline. Moreover, the output of specialty products (potatoes, broilers, and blueberries) will be regulated more and more by the capacity of processing plants and the development of marketing techniques that meet the needs of an ever more service-conscious ultimate consumer. We estimate conservatively that cash receipts from farm marketings will rise above the $200 million level during the 1960's (see Table XXIX), and that realized net income per farm will stay at or slightly above the U. S. average. (See Table XXX.)

C. WASHINGTON COUNTY

By all indices but one (blueberry production), Washington County lags behind the state average in land utilization, capitalization of farms, farm output, and income. Only 12% of the county area was in farms in 1954; this decline of 25% in farm acreage between 1950 and 1954 might be indicative of a decrease in subsistence farming. Even so, only 419 of the county's 1120 farms were classed as commercial in 1954, and more than half of those had incomes of less than $2500. (See Table XXXI.)

In the same year, the average value of land and buildings per farm was only $5579 (60% of the state average); on a per acre basis, it was $31.62 (52% of the state average). The value of all farm products sold is shown in Table XXXII for two census years. Blueberries represented the bulk of all crop sales, while milk and poultry products accounted for most of the livestock products. In both years, Washington County accounted for less than 2%, by value, of all farm products sold in the state (see Table XXXIII), although by number of commercial farms, population, and cropland harvested, it represented a larger proportion of the state total.

In 1954, blueberries were harvested for sale on 461 of the county's farms and from 11,278 acres--about 45% of the cropland harvested. The county's contribution to Maine's total blueberry output generally fluctuates between 35 and 50%. A large portion of the crop is completely processed in the county; the rest is partially processed there. The future of Washington County's blueberry industry depends primarily on the continued availability of cheap and efficient labor. (In 1957, it was reported that the harvesting cost per pound had risen above the state average because of increasing labor costs.)

More than one half of the state's crop of berries is frozen, and the outlook for a continued rise in U. S. per-capita consumption of frozen foods is favorable. Our projected 30% increase in frozen-fruit consumption by 1965 is based on rising consumer incomes, the increasing number of women working outside the home, the continuing population shift from rural to urban areas, and the growing number of meals eaten away from home.

Too much emphasis, however, should not be placed on a single specialty crop such as blueberries, because the growing requirements, except for the low wage level of Washington County, could be met by many other areas in the Northeast. The future of agriculture in the county depends on product diversification and further concentration of production on efficient farms. Since 1954, there has been a substantial increase in the number of chickens; cash receipts from the sale of poultry products exceeded $1 million in 1957. According to the county agent, there is a good opportunity for expanding sheep raising. Since the primary market for lamb is in the New England states, Washington County might produce sheep on some of its 20,000 acres of cropland that are neither harvested nor pastured.

We conclude that although Washington County's agricultural resources are not fully exploited, lack of local capital and distance from markets will continue to depopulate the rural areas and contribute to the county's population decline.

these additions to income would exert an important upward pressure on the construction industry and the wholesale and retail trades, we do not believe that they would exercise a significant influence on the course of Maine's economic development. In this connection, an announcement that the tidal project would be undertaken might lead to a curtailment of plans to increase private thermal and hydroelectrical generating capacity to a degree that would substantially offset the effects predicted above. In short, the Passamaquoddy power project seems likely to have a very small impact on the Maine economy as a whole. The economy of Washington County, however, would be temporarily transformed by the influx of several thousand workers and the generation of new income of at least $7 million in wages alone.

Although employment would be increased and trade and residential construction temporarily stimulated, the long-run effects of the construction would not, in our opinion, be sufficient to set in motion forces that would fundamentally change the nature of Washington County's economic problems. In fact, the higher wages accompanying the increase in economic activity might reduce employment and output in the garment and food-processing industries to the permanent detriment of the county's economy.

Our studies indicate that the impact of the operation of the proposed power project would not be significant unless electric power were made available to industry at a rate of 3.5 mills per kilowatt-hour. In this event, we believe that electrometallurgical plants, which would provide direct and indirect employment for about 2000 workers, would be attracted to Washington County.[1] This would, of course, lead to the establishment of Washington County as an important industrial area and provide an important new source of employment and income. Maine's locational disadvantage would not, however, be overcome by low power costs, and the course of economic development in the state of Maine as a whole would not in our opinion be significantly affected.

1. See Introduction to Part Two.

TABLE XXX

REALIZED NET INCOME PER FARM IN MAINE, THE NORTH ATLANTIC STATES, AND THE UNITED STATES, 1950-1956[1]

	1950	1951	1952	1953	1954	1955	1956
Maine	$1,807	$2,071	$2,991	$1,879	$ 972	$2,408	$2,312
North Atlantic States[2]	1,879	2,387	2,530	2,415	1,954	2,235	2,217
United States	2,276	2,674	2,630	2,615	2,344	2,277	2,432
Maine as a Percentage of the United States	79	77	114	72	41	106	95

1. Excludes changes in inventories.

2. Maine, Vermont, New Hampshire, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.

Source: United States Department of Agriculture, Agricultural Marketing Service.

TABLE XXXI

COMMERCIAL FARM INCOME IN MAINE, 1954

Income (dollars)	Number of Farms
25,000 and more	14
10,000 - 24,999	21
5,000 - 9,999	54
2,500 - 4,999	109
1,200 - 2,499	126
250 - 1,199	95
All Commercial Farms	419

Source: Census of Agriculture, 1954.

TABLE XXXII

VALUE OF FARM PRODUCTS SOLD IN WASHINGTON COUNTY

	1954	1949
All farms (number)	1,120	1,656
All farm products sold (dollars)	2,340,438	2,415,742
All crops sold	1,022,941	1,138,149
Field crops sold	149,306	203,321
Vegetables sold	29,866	98,658
Fruits and nuts sold	821,269	814,433
Horticultural specialties	22,500	21,737
All livestock and livestock products	964,144	999,892
Dairy products	431,812	501,683
Poultry and poultry products	425,148	336,223
Other livestock	107,184	161,986
Forest products sold	353,353	277,701

Source: Census of April, 1950, and October, 1954.

TABLE XXXIII

VALUE OF FARM PRODUCTS COMPARED: WASHINGTON COUNTY AS A PERCENTAGE OF MAINE

	1954	1949
All farm products sold	1.6	1.9
All crops sold	1.6	1.7
Fruits and nuts sold	21.1	27.1
All livestock and livestock products sold	1.4	1.8
Dairy products sold	1.8	2.3
Poultry and poultry products sold	1.0	1.3

Source: Census of April, 1950, and October, 1954.

V. FISHING INDUSTRY

The fishing industry is historically one of the most important segments of Maine's economy. Recent years have witnessed significant changes in the fishing industry as Maine fishermen have become responsive to changes in consumer demand for fish. Fish has consumer appeal based on its lower price than meat and on the demands of certain religious groups. As a result of increased personal income, consumer demand for more expensive meat has increased, while per-capita consumption of fish has decreased. Total fish production has, however, increased along with population growth, and this trend may be expected to continue. Imported frozen groundfish fillets will capture most of this increase, with small shares going to other luxury type items such as lobsters. Growth is expected in Maine's lobster industry with some near-term decline indicated for the sardine industry.

A. LANDINGS

Landings of commercially caught fish and shellfish at Maine ports in 1956 totaled 277.8 million pounds valued at $17 million to the fishermen. These landings represented an increase of 9% in volume and 5% in value compared with 1955. Decreases in landings of ocean perch, whiting, and lobsters were offset by a 41% increase in the catch of sea herring. Cumberland County led all others in production with 86 million pounds, followed by Knox County (74.1 million pounds) and Washington County (61.8 million pounds). In terms of pounds of fish landed in Maine, the order of importance in 1956 was:

1. Herring (sardines)
2. Ocean perch (redfish)
3. Lobsters
4. Groundfish (cod, flounder, haddock, etc.)
5. Whiting

In terms of value of catch, the ranking was:

1. Lobsters
2. Ocean perch
3. Herring
4. Groundfish
5. Clams

In 1956, lobsters represented 54% of the total value of fish landings in Maine. Ocean perch followed with 15% of the value of catch, and

herring with 14% of total value. Lobster landings were concentrated in Hancock and Knox Counties, perch in Cumberland and Knox Counties, and herring and clams in Washington County. In 1955, 27% of the volume and 14% of the value of Maine's catch were received at Portland, and 19% of the volume and 10% of the value were received at Rockland. However, significant landings are made at a number of harbors along the coast.

The volume of fish landed in Maine has increased modestly during the past decade. The total growth in pounds during the period 1947 through 1956 was 26%. However, this apparent increase is due chiefly to the small volume of 1947 landings; the period 1948 through 1956 showed a net decline. The total value of Maine fish landings has likewise shown a modest growth trend. A summary of Maine landings for the period 1947 through 1956 is shown in Tables XXXIV and XXXV. It can be seen from these tables that the stabilizing growth trend of the lobster catch has been offset by consistent fluctuations in the size and value of the herring catch, resulting in an inconsistent pattern of volume and sales for the industry.

In an excellent paper on the economics of the Maine lobster industry,[1] Messrs. Dow and Trott point out that biological factors have not affected the lobster production, but the lobster fishermen maintain a keen awareness of lobster price fluctuations and control production accordingly. Their study shows an unexpectedly high and consistent correlation between the price per pound paid for lobsters and the number of traps fished, and in turn, the production of lobsters. The same consistency between economic factors and production apparently does not exist in the other segments of the fishing industry. Figures 8, 9, 10, and 11 show the annual variations in catch and value of the major species fished and the effect on total volume and value of fluctuations in the individual species.

B. PRODUCTION AND EMPLOYMENT

In 1955, fishing employed 715 fishermen on vessels and 8295 (5399 regular and 2896 casual) on boats. Vessels used in transporting fishery products employed an additional 136 persons. Maine wholesaling and manufacturing establishments in the fishing industry employed a seasonal average of 7034 persons and an annual average of 3511 persons in 1955. In 1957, the value of manufactured fishery products (canned and cured sea foods) was $18.7 million and employed an average of 1674 workers, of whom 62% were female.

1. "A Study of Major Factors of Maine Lobster Production Fluctuations," Robert L. Dow and Theodore T. Trott,, Jr., August, 1956.

TABLE XXXIV

QUANTITY OF MAINE LANDINGS IN THOUSAND POUNDS

Year	Lobsters	Herring	Groundfish	Other	Total
1947	18,277.1	121,317.6	63,723.8	17,026.6	220,345.1
1948	15,923.1	182,461.0	85,396.9	21,256.5	305,037.5
1949	19,272.5	149,893.9	93,406.4	29,630.8	292,203.6
1950	18,352.5	185,481.5	124,455.6	24,990.3	353,279.9
1951	20,759.5	59,738.1	118,535.9	21,889.2	220,922.7
1952	20,036.2	144,661.3	109,498.9	21,587.2	295,783.6
1953	22,300.4	100,586.4	95,188.4	23,483.5	241,558.7
1954	21,667.7	123,602.1	109,295.9	29,340.2	283,905.9
1955	22,718.1	99,415.8	110,861.8	22,435.6	255,431.3
1956	20,572.3	140,472.3	98,543.6	18,233.7	277,821.9

Source: Department of Sea and Shore Fisheries, Augusta, Maine.

TABLE XXXV

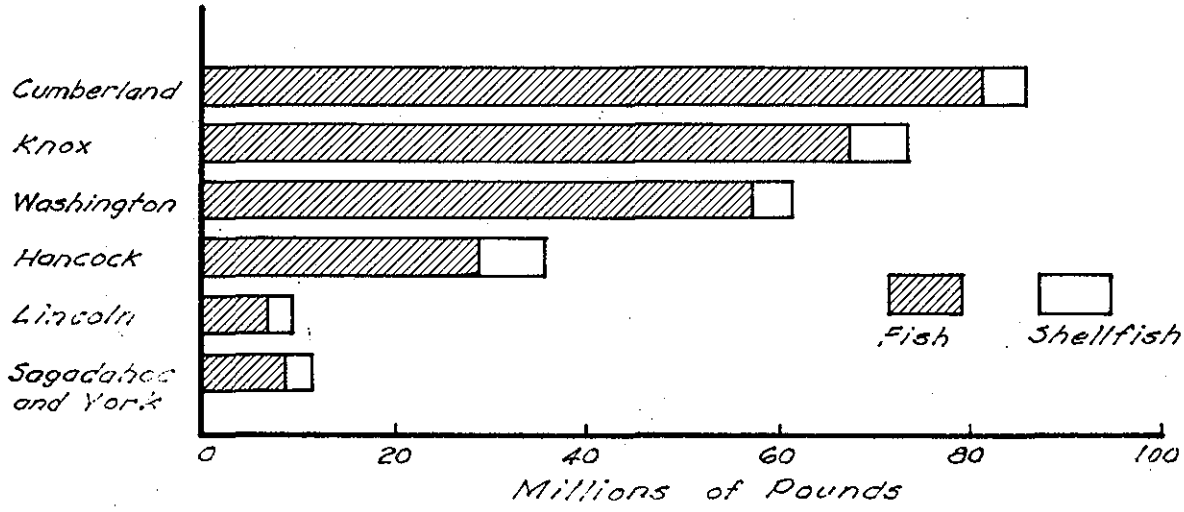
VALUE OF MAINE LANDINGS IN THOUSAND DOLLARS

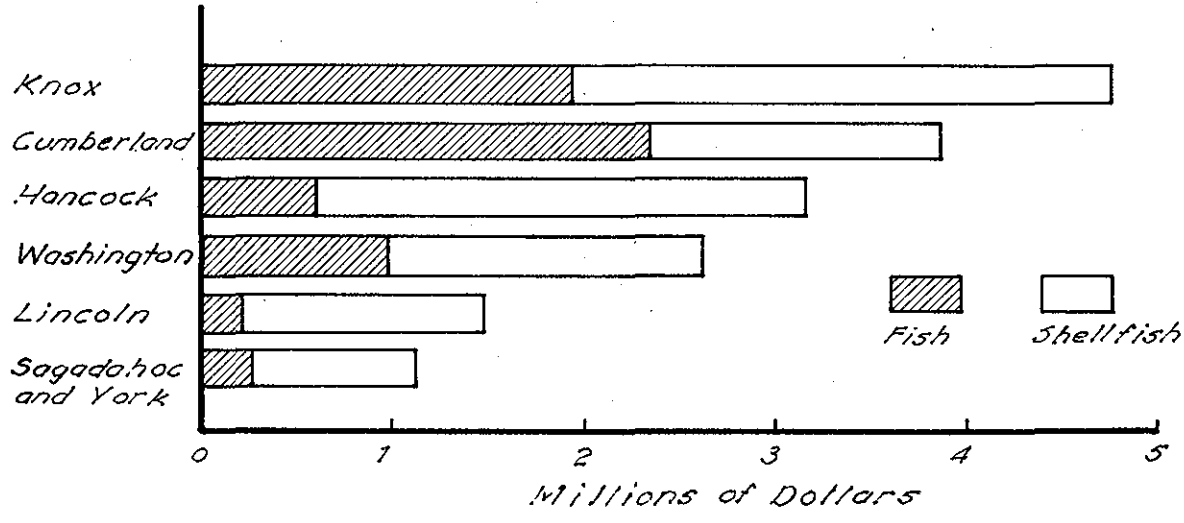
Year	Lobster	Herring	Groundfish	Other	Total
1947	$6,816.2	$1,515.5	$2,158.9	$2,379.5	$12,870.1
1948	6,439.5	3,486.5	3,242.3	3,015.3	16,183.6
1949	6,697.0	2,408.4	3,337.7	6,544.9	18,988.0
1950	6,412.3	1,269.5	4,728.6	2,278.3	14,688.7
1951	7,214.1	913.7	5,192.4	2,285.8	15,606.0
1952	8,511.8	1,752.5	4,309.4	3,323.3	17,897.0
1953	8,411.2	1,621.2	3,720.3	3,001.5	16,754.2
1954	8,087.2	1,769.5	4,477.2	2,521.7	16,855.6
1955	8,716.0	1,353.0	3,768.0	2,246.2	16,083.2
1956	9,119.8	2,299.3	3,510.0	2,036.5	16,965.6

Source: Department of Sea and Shore Fisheries, Augusta, Maine.

FIGURE 8

Landings and their Value, at Maine Ports, by Counties, 1956





Source: Maine Landings, 1956 by County and Gear
Department of Sea and Shore Fisheries
Augusta, Maine

FIGURE 9

Weight and Value of Maine Fish Landings
Lobster

FIGURE 10

Weight and Value of Maine Fish Landings
Herring

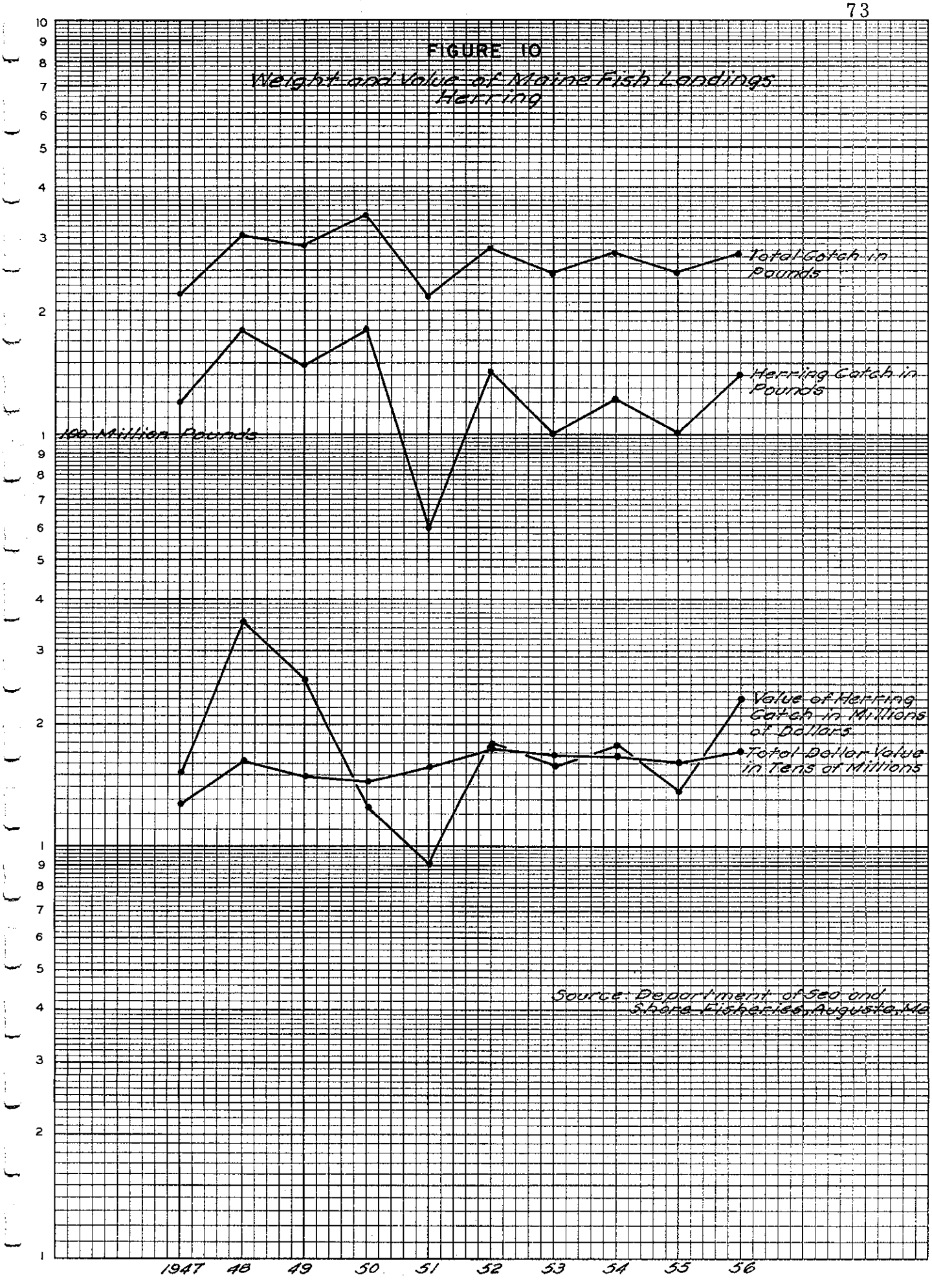
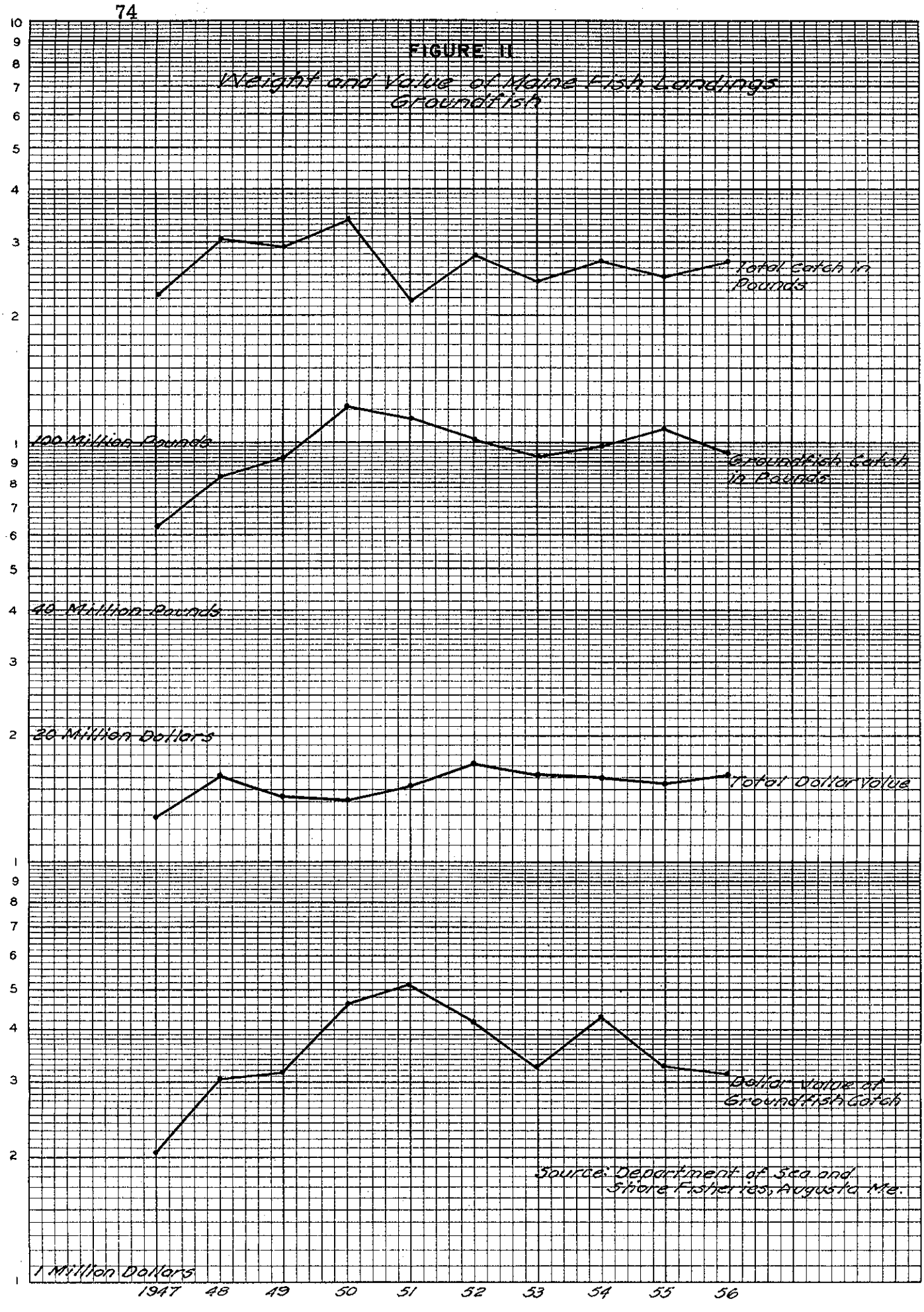


FIGURE II

Weight and Value of Maine Fish Landings
Groundfish



Source: Department of Sea and Shore Fisheries, Augusta Me.

The production of canned sardines dominates the manufacture of fishing products in Maine. The sardine pack in 1955 was valued at $9.3 million, equal to 28% of the total value of Maine's manufactured fish products. Production of fresh and frozen ocean perch fillets is second in importance among manufactured fish products, accounting in 1955 for 14% of value of product. Processed clams are third in value among Maine fish-product manufacturing.

Employment in the fish-product manufacturing industry in Maine is highly seasonal and keyed toward part-time employment of housewives living in the small towns where fish-processing plants are located. In 1957, the average gross wage in the fish-processing industry was $2341 compared with $3551, the average for all manufacturing.

C. CONSUMPTION

Historically, total-fish-consumption patterns have changed very little. Fish demand is based primarily on the requirements of certain ethnic and religious groups, and secondly on the appeal of fish as a low-cost food. The U. S. per-capita consumption of fish products has shown a slight but steady decline during the past 20 years. The total decrease from 1935 to 1956 in per-capita consumption was 8%, and consumption has remained relatively constant, at 10 pounds per capita during the past two years. Total consumption has, however, increased in proportion to total population increases. The most significant fact relating to fish consumption has been the growth in consumption of certain species and the concomitant decline in the consumption of other species. According to the U. S. Tariff Commission Groundfish Report for 1957, U. S. consumption of fresh and frozen groundfish increased from 105.8 million pounds in 1939 to 232.5 million pounds in 1956. This represents an increase of 120%. This increase has been at the expense of canned, cured, and other fresh fish. The Maine fishing industry has participated in this growing demand for fresh and frozen groundfish. Landings of groundfish in Maine increased from 63.7 million pounds in 1947 to 98.5 million pounds in 1956, an increase of 54%. The value of the Maine landings of groundfish increased 63%, from $2.2 million in 1947 to $3.5 million in 1956. The ocean perch is the principal groundfish species landed in Maine. Landings of ocean perch were insignificant prior to 1941; but since that time, they have become of major importance to the industry. (See Table XXXVI.)

TABLE XXXVI

MAINE LANDINGS OF OCEAN PERCH

Year	Pounds
1941	20,726,758
1942	26,446,755
1943	25,792,734
1944	24,267,951
1945	27,806,599
1946	41,076,852
1947	39,988,130
1948	49,041,410
1949	55,502,605
1950	79,281,327
1951	73,941,835
1952	60,468,154
1953	60,623,164
1954	79,670,711
1955	67,684,954
1956	64,966,871

An all-time high for the groundfish industry, both abroad and in the United States, came during the Korean War, when demand for meat forced meat prices to a record high. Of the groundfish consumed in the United States, haddock accounts for approximately 35%; cod, 35%; and ocean perch, 27.5%.

Projecting the recent relatively constant per-capita consumption of frozen groundfish (1.2 pounds), we estimate a total U. S. consumption of roughly 213,408,000 pounds by 1960 and 228,355,000 by 1965. (See Table XXXVII.)

TABLE XXXVII

PROJECTED U. S. CONSUMPTION OF FROZEN GROUNDFISH

Year	U. S. Population	Consumption (pounds)
1957	170,263,000	204,316,000
1958	172,774,000	207,329,000
1959	175,299,000	210,359,000
1960	177,840,000	213,408,000
1965	190,296,000	228,355,000

Source: U. S. Census Bureau for population figures; Arthur D. Little, Inc., estimates for consumption data.

The preponderance of production to meet the growth in consumption will come from imports. Production in the United States declined from 94.9% of consumption in 1939 to 46.0% in 1956. Table XXXVIII summarizes U. S. groundfish consumption, production, and imports; and this information is shown graphically on Figure 12.

TABLE XXXVIII

U. S. CONSUMPTION, PRODUCTION, AND IMPORTS OF FRESH OR FROZEN GROUNDFISH[1]
(millions of pounds)

Year	Consumption	U. S. Production	Percent of Consumption	Imports	Percent of Consumption
1939	105.8	100.4	94.9	9.4	8.9
1940	100.7	90.6	90.0	9.7	9.6
1941	130.8	122.5	94.0	9.9	7.6
1942	126.5	105.1	83.5	16.7	13.2
1943	106.9	86.5	80.9	16.3	15.3
1944	129.2	108.6	83.5	24.5	19.0
1945	162.8	126.4	77.5	43.1	26.5
1946	157.4	126.7	80.5	49.2	31.3
1947	163.6	115.3	70.9	35.0	20.5
1948	183.2	137.7	75.0	53.9	29.4
1949	193.8	140.0	72.5	47.3	24.5
1950	193.8	136.6	70.5	64.9	33.5
1951	238.1	148.8	62.5	87.6	36.8
1952	224.0	136.6	60.1	107.4	48.0
1953	216.3	112.3	51.7	89.7	40.5
1954	238.9	122.4	51.0	137.5	57.3
1955	243.6	105.6	43.0	128.3	52.1
1956	232.5	107.1	46.0	138.6	59.3

1. Differences between percentages shown and 100% accounted for by cold-storage changes.

Source: U. S. Tariff Commission Groundfish Report, 1957.
U. S. Fish and Wildlife Service data for 1956.

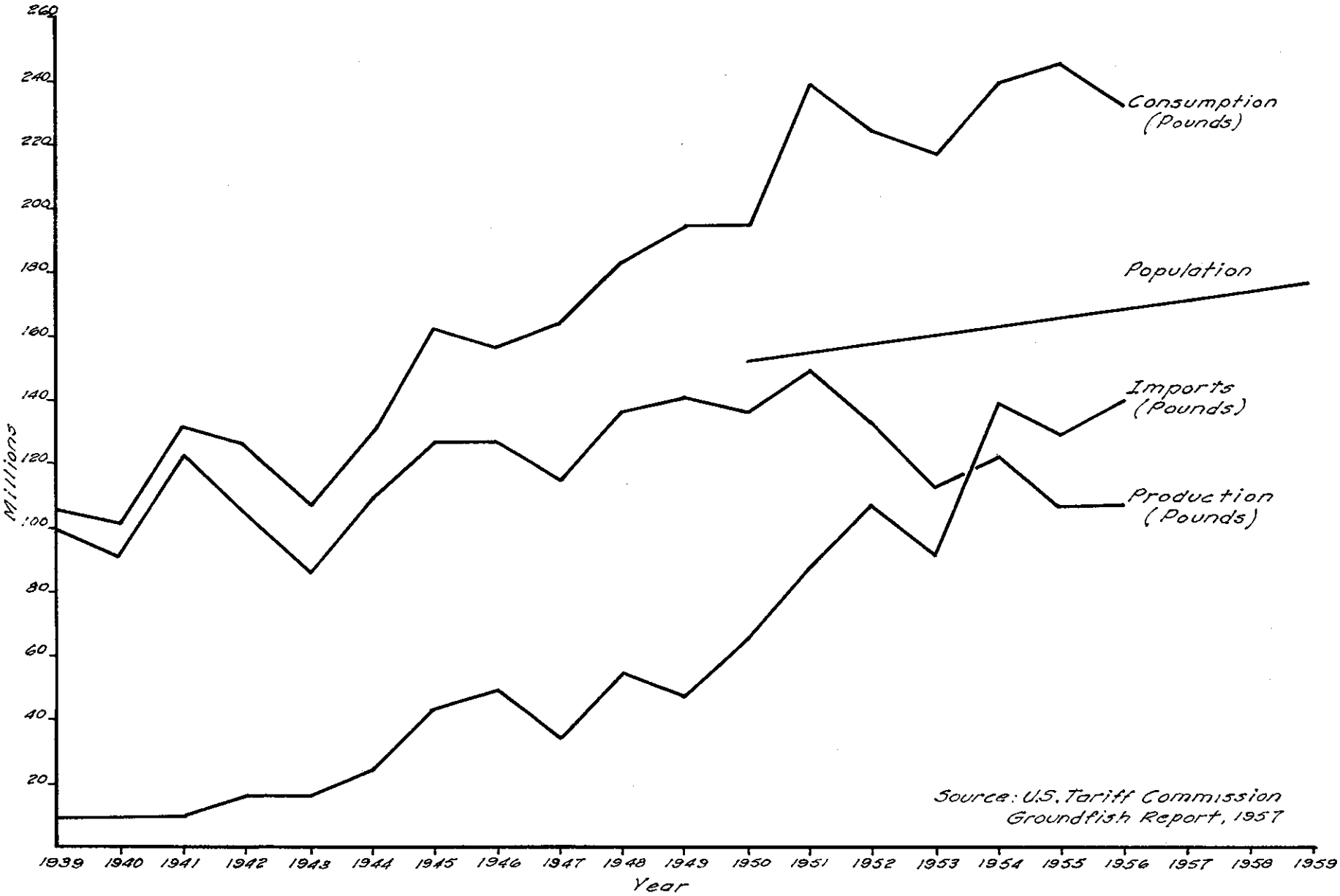


FIGURE 12

U.S. Consumption, Production, and Imports of Groundfish Fillets and Slabs (Fresh or Frozen), 1939 -1956

With U. S. production failing to make any lasting gains in total poundage and losing ground as a percentage of U. S. consumption, imports will be increasingly important. The groundfishing industry in Maine should, however, remain in its present position. As a result of higher costs, labor, and other difficulties, it seems unlikely that any expansion in Maine's groundfisheries may be expected. On the other hand, U. S. Government efforts (for instance, under the Saltonstall-Kennedy Act) are combining with management and labor to prevent any further decline in the catch. A lowering of quota or a rise in tariff on imports of groundfish could act to prevent imports from gaining substantially all of the expected increase in market. This action has been advocated by the New England industry and their representatives in Congress. The U. S. Tariff Commission has concurred in this thinking. Only a veto of the Tariff Commission's recommendation by President Eisenhower has prevented a change in the existing tariff regulations on groundfish.

The increased share of the relatively stable fish-products market that has been attained by groundfish has been made at the expense of fresh fish and canned and cured fish. In Maine, the sardine industry has suffered the majority of this lost market. The herring catch has shown no over-all growth pattern, in spite of population growth. The Maine sardine industry has survived because, more than other segments of the fishing industry, it appeals as a low-cost food. As a result of postwar prosperity, some of this appeal has diminished. Per-capita consumption of canned sea food has declined 29% from 4.8 pounds per person in 1939 to 3.42 pounds per person in 1956. For comparison, per-capita consumption of meat increased 16% from 144.6 pounds in 1949 to 166.8 pounds in 1956. Continued prosperity, and the resulting appeal of more expensive food items, will act as a restricting factor on the sardine industry. Of long-range interest is the reduction of herring into an edible, tasteless, high-protein meal designed for human consumption in protein-underdeveloped areas of the world, such as the Caribbean and Central America. The interest, to a large extent, depends on a low cost for the basic resource fish.

In spite of its large-scale fluctuations, the sardine industry does offer some stability to the communities where processing plants are located. As a result of the type of work involved and its seasonality, housewives make up the bulk of employment. Their compensation, including the unemployment benefits that they draw, serves as a supplemental source of income to many families. Although the wages paid are low, the situation lends itself to the continued availability of this type of labor which, in turn, will assure the continuance of low-cost fish processing in Maine.

One segment of Maine fisheries in particular has benefited from the growth in demand for more expensive food products. The lobster industry has shown a consistent growth trend since 1939. A high of 22.7 million pounds was landed in 1955. This represents an increase of 242% over 1939 landings. Although there has been no growth trend in the price per pound paid for lobsters, the increased catch has made a significant increase in the income of Maine fisheries.

Further growth in the lobster industry is dependent upon improved marketing techniques. Technological difficulties have prevented the establishment of a frozen lobster industry. Difficulties in shipping live lobsters to distant markets have been a restricting factor. Improvements in the methods of prolonging lobster life by use of recirculated natural or artificial sea water will continue to improve marketing conditions. Biological factors apparently are not now operating to restrict production. Increased production is expected and should parallel technological improvements for prolonging lobster life after the fish is caught.

D. WASHINGTON COUNTY

The economy of the Passamaquoddy area depends primarily on fishing and related industries. Data on the value of manufactured products in the Passamaquoddy area have been obtained from the Maine Department of Labor and Industry. The value of these products in shown in Table XXXIX.

During the eight-year period, 1949-1956, products manufactured from fish resources (includes only herring, alewives, and trash fish) averaged $13,399,104 in value annually and represented 75% of the value of all products manufactured in the area.

Of the nine municipalities in the Passamaquoddy area, Calais, Eastport, and Lubec are the most important with respect to manufactured product value.

Year	Calais	Eastport	Lubec	All Others[1]
1949	$1,072,577	$5,543,733	$8,446,494	$853,383
1950	1,881,472	5,799,137	10,412,791	957,033
1951	3,615,558	5,049,819	7,359,889	779,873
1952	3,775,502	6,209,237	9,378,515	797,059
1953	4,134,070	3,963,244	6,465,055	438,447
1954	5,178,091	3,691,056	8,335,583	977,653
1955	5,078,245	5,017,338	7,128,098	384,756
1956	2,591,542	6,330,025	9,566,843	526,984

Of these, only Calais is not dependent upon marine resources for economic existence.

Percentage of Fisheries Products to Total Product Value

Year	Eastport	Lubec	All Others
1949	97.8	98.5	100.0
1950	98.0	98.8	98.9
1951	95.7	98.2	91.7
1952	97.6	99.0	92.1
1953	96.3	99.4	82.0
1954	88.2	99.7	94.7
1955	52.6	99.6	76.5
1956	58.5	99.8	80.5
Average	85.6	99.1	89.6

1. Includes Pembroke, Perry, Robbinston and Trescott.

TABLE XXXIX

VALUE OF MANUFACTURED PRODUCTS IN THE PASSAMAQUODDY AREA

Year	All Products	Fisheries Products[1]	% Represented by Fisheries Products
1949	$16,546,187	$14,597,207	88.2
1950	19,050,433	16,919,410	88.8
1951	16,805,139	12,785,143	76.1
1952	20,160,313	16,077,714	79.7
1953	15,000,816	10,604,794	70.7
1954	18,182,383	12,491,737	68.7
1955	17,608,437	10,038,634	57.0
1956	19,015,394	13,678,196	71.9
Average	$17,796,138	$13,399,104	75.3

1. Includes American Can Company.

The herring fishery is by far the most important. It accounts for about 85% of total landings in Washington County, provides a major source of employment, and represents the greatest investment in plant and equipment. It involves substantial marine equipment and numerous factories that are used for the canning of sardines and the manufacture of pet food, fish meal, pearl essence, and other specialty products. Supporting activities include the fabrication of tin cans (American Can Company, Lubec) and the maintenance of a railhead in Eastport (Maine Central Railroad). These operations are practically the sole support of the local economy.

The landings of other species of fish are shown in Table XL.

1. Method of Catching

Herring are caught in stop seines, weirs, and purse seines, depending on local conditions. Stop seines are most productive because of the inherent mobility of such equipment. Stop seines, however, are subject to damage in waters where the tidal currents are strong, and this is one of the reasons why they are not generally used in the Passamaquoddy area.

Approximately 66 stop seining rigs are used in the herring fishery along the coast of Maine, but only about 9 of these operate in the Eastport-Lubec vicinity. Stop seines accounted for about 55% of the 42 million pounds of herring landed annually in Washington County by American fishermen. No figures were obtainable for the local Eastport-Lubec area.

Weirs are a popular type of fishing gear in the vicinity of Passamaquoddy Bay. Out of a total of about 164 weirs along the coast of Maine, 106 are located in Washington County, and 21 of these are in the area that would be directly affected by the Passamaquoddy project. The reason for their popularity along the eastern end of the coastline is the ability of this equipment to perform under the prevailing tidal conditions. Its effectiveness, however, is limited by the permanency of location and, in some instances, by problems in timing the removal of fish from the water. The value of a typical weir is approximately $5500, and a weirman's boat would probably account for another $1500. During the 1953 through 1957 period, an average of 16,162,000 pounds of herring were caught per year in Washington County weirs. This amount represents about 38% of the total for all methods used by American fishermen.

The corresponding figures for this statewide herring fishery are:

Weirs	27,020,000 pounds	22%
Stop seine	88,242,000 pounds	71%
Purse seine	8,277,000 pounds	7%
Average annual total landings	123,539,000 pounds	

2. Canadian Fish

All of the previous figures apply to landings by American fishermen. Additional landings in Washington County by Canadian fishermen have averaged 24,136,400 per year during the past five years.

Practically all the landings of Canadian herring in Maine are confined to Washington County and are imported on a duty-free basis.

3. Utilization of Herring

We estimate that in Washington County and under average conditions, 62% of the herring is utilized for the canning of sardines, 28% for the preparation of pet food, and 10% for the manufacture of fish meal and pearl essence.

The amount and proportion of herring which are utilized for the canning of sardines vary considerably from year to year, and the pattern for Washington County is different from that for the rest of the state. These variations are illustrated in Table XLI.

The lower percentages for Washington County are due to the greater concentration of secondary plants which utilize herring for the manufacture of pet food, fish meal, and pearl essence.

4. Sardine Operations in Washington County

There is a total of 19 sardine canneries in Washington County, but it is our understanding that only 15 will operate during the 1958 season.

TABLE XL

LANDINGS OF FISH AND SHELLFISH (EXCLUSIVE OF SEA HERRING) IN THE U. S. PASSAMAQUODDY AREA 1948-1957

Species	1948		1949		1950		1951		1952		1953	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Cod	40,940	1,509	16,151	530	26,357	798	15,294	406	16,930	698	14,018	409
Haddock	45,392	3,170	52,337	2,237	15,996	1,261	20,357	1,469	41,213	2,683	26,955	1,923
Pollock	151,728	4,466	422,264	4,636	134,290	1,371	142,962	2,273	367,010	1,835	621,920	6,827
Alewives	333,494	1,717	241,696	2,417	328,514	2,999	124,251	950	230,435	3,538	91,878	1,311
Eels	2,048	446	3,861	819	6,545	1,063	6,127	1,225	8,278	1,794	6,164	1,286
Smelt	37,124	13,765	12,732	3,549	8,258	3,051	4,155	1,053	6,090	1,532	8,999	1,608
Periwinkles	2,952	1,018	1,800	713	720	240	2,901	961	3,082	972	7,071	2,041
Soft Clams	109,906	16,376	443,774	61,685	523,383	86,882	243,976	53,187	224,279	60,553	218,645	68,436
Lobster	975	389	1,149	380	888	298	450	151	975	395	1,200	436
Sea Scallops	19,813	8,340	20,066	6,634	40,408	15,741	33,313	14,130	40,499	22,315	16,937	9,095
TOTAL	744,372	51,196	1,215,830	83,600	1,085,359	113,704	593,786	75,805	938,791	96,315	1,013,787	93,372
Atlantic Salmon*	79		63		39		31		39		39	

*Number of fish only.

(Average annual value exclusive of herring and clams $26,958.)

TABLE XL (Continued)

Species	1954		1955		1956		1957		Total		Average	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Landings	Value	Landings	Value
Cod	13,076	493	57,245	2,069	18,631	595	15,911	550	234,553	8,057	23,455	806
Haddock	21,772	1,672	14,767	1,022	19,605	1,374	18,252	1,455	276,646	18,266	27,665	1,827
Pollock	9,406	275	291,806	1,663	276,949	2,689	327,000	2,518	2,745,335	28,553	274,534	2,855
Alewives	276,057	2,347	619,250	5,265	289,200	4,131	180,810	1,788	2,715,583	26,463	271,559	2,646
Eels	385	77	2,785	585	3,999	794	2,654	794	42,846	8,883	4,285	888
Smelt	4,795	1,370	4,313	1,112	3,328	1,019	5,669	1,287	95,463	29,346	9,546	293
Periwinkles	3,724	1,166	5,232	1,571	17,610	5,354	12,600	4,178	57,692	18,214	5,769	1,821
Soft Clams	267,248	89,795	168,926	57,097	211,049	70,912	167,308	58,558	2,578,498	623,481	257,849	62,348
Lobster	975	362	1,275	480	1,062	449	1,149	421	10,098	3,761	1,010	376
Sea Scallops	17,459	7,577	54,939	29,228	46,431	23,726	35,653	17,673	325,518	154,459	32,552	15,446
TOTAL	614,897	105,134	1,220,538	100,092	887,864	111,043	767,006	89,222	9,082,230	919,483	908,223	91,948
Atlantic Salmon*	100		35		89		34					

*Number of fish only.

Source: Department of Sea and Shore Fisheries, Augusta, Maine.

TABLE XLI

CONSUMPTION OF HERRING BY SARDINE INDUSTRY

Year	Washington County		State Total	
	Amount (pound)[1]	Percent of Landings	Amount (pound)[1]	Percent of Total Landings
1953	30,400,000	58	131,900,000	Unaccountable
1954	73,500,000	Unaccountable	174,000,000	Unaccountable
1955	2,230,000	7	76,000,000	72
1956	50,000,000	77	133,800,000	90
1957	44,900,000	40	128,000,000	61
Average	40,206,000	--	128,740,000	--

1. Based on average yield of 480 pounds of net packed production per 1225-pound hogshead.

This curtailment is apparently due to overcapacity in the industry and to other economic factors, such as higher transportation costs.[1] Operation in Washington County, however, still represents a significant proportion of Maine production as indicated in Table XLII.

TABLE XLII

PRODUCTION OF SARDINES IN WASHINGTON COUNTY

Year	Standard Cases	Percent of Maine Total
1953	502,862	23.0
1954	1,212,499	42.0
1955	368,162	29.0
1956	823,648	38.0
1957	740,003	35.0
Average	729,435	33.4

5. Distribution of Revenue

The average of 729,435 cases per year represents a gross annual revenue of about $5,651,000. The estimated distribution of this revenue is shown in Table XLIII.

The $777,200 difference between the figures for gross revenue and disbursed expenses includes brokerage fees, discounts, state taxes, depreciation, and interest.

6. Scrap

The scrap loss in processing sardines amounts to approximately 41% of the weight of fish delivered to the cannery. It is normally sold to

1. About 15¢ more per case from Eastport than Portland.

TABLE XLIII

ESTIMATED DISTRIBUTION OF REVENUE

Item	Amount
Fish	$ 680,000
Oil and sauce	433,000
Salt	93,000
Cans	1,790,000
Cases	93,000
Factory labor, maintenance, and supervision	1,241,000
Office personnel and management	300,000
Insurance and property taxes	91,000
Fuel	113,000
Electricity	11,600
Supplies	13,200
Telephone	15,000
Total	$4,873,800

a reduction plant for around $7.50 a ton, and represents an average revenue of about $62,000 to the cannery operators in Washington County.

7. Plant Investment

Under normal conditions, the depreciated value of a typical sardine cannery, including marine equipment, would be approximately $150,000, and on the basis of this figure the depreciated value of the 19 canneries in Washington County would total $2,850,000. Two canneries, however, have reportedly changed hands in recent years in the Eastport-Lubec area for around $100,000 and $125,000 each. To erect a modern cannery at present-day costs would involve an expenditure of about $400,000.

8. Employment

The 15 canneries which operated in Washington County during 1957 employed a total of about 2300 hourly and piece-rate workers who earned an average of about $500 for the year. About 1500 of these people received unemployment compensation, while the remaining 800 either supplemented their income with other work or failed to earn enough ($300 minimum) to be eligible for unemployment relief.

Operations are usually limited to the July 1 to October 31 period with employment being on an "on-call" basis. These conditions are dictated by the perishable nature of the fish and the unpredictability of the supply.

About 60% of the factory personnel are women who perform the trimming and packing operations on a piece-rate basis. It appears that the part-time nature of the work appeals to local housewives, and it is reasonable to assume that this source of labor will always be available for the sardine industry. Most canneries retain one or two office workers and a production supervisor on a full-time basis. Their annual salaries range from $2500 to $5000 per year.

9. Reduction Plants

The reduction plants are another important segment of the fishing industry, and they also contribute significantly to the local economy. There are four such plants in Washington County, and all of them are located in the Eastport-Lubec area. Their operation is closely related to the production of sardines since the reduction plants are largely dependent on cannery scrap as a low-cost source of raw material. Other raw materials include a relatively small amount of waste from the pearl essence, smoked herring, and groundfish industries, plus small amounts of alewives and varying amounts of whole herring. The proportion of whole herring depends on the size and condition of the fish and the abundance of the supply. In all cases, cost is a determining factor.

Products of the reduction plants include fish meal and oil, and at least one plant has a modern stick-water system to recover a high-protein animal meal and an animal-feed adjunct containing 50% of soluble solids.

Operations in a typical reduction plant include cooking the scrap, processing the cooked material, drying the press cake, settling and/or centrifuging the press liquor, disintegrating the dried press cake, and bagging the disintegrated meal. The processing equipment is normally designed for continuous operation, but irregularities in the supply and the perishable nature of the raw materials frequently necessitate intermittent scheduling. The annual operating period is also more or less geared to that of the sardine canneries, and these restrictions limit the potential return on the capital investment.

The four plants represent an estimated total investment of approximately $1,600,000 and produce an estimated annual total of 4970 tons of meal from 22,600 tons of raw material. The gross annual revenue from the sale of meal is around $620,000, and at $7.50 per ton the value of raw material would amount to $169,500. No figures were obtained on the value and production of fish oil.

The industry employs an estimated total of 36 direct workers on a more or less sporadic basis. If it is assumed that they earn an average of $1.15 per hour, and 5.8 man-hours are required to produce a ton of meal, their individual wages would amount to $800 per year, or a total of $28,600. We estimate that 12 additional people are employed on a part- or full-time basis for supervising, management, and clerical activities, and that their combined salaries amount to $36,000.

a. Pet Food

There are two pet-food factories in Washington County in the Lubec area. Although both are important to the general economy, the larger one is likely to be more stable because of its affiliation with a well-known national organization.

Pet foods for canine consumption generally contain a variety of materials, but fish is the basic ingredient. The fish in a well-known cat food consists of a mixture of herring, alewives, and pollock, with herring accounting for 60-75% of the blend. We estimate that the local industry presently consumes over 30 million pounds of fish per year and provides part- or full-time employment for 115 people who receive around $225,000 per year in salaries and wages. Other revenues from the pet-food industry include $1,792,000 for cans, $6700 for power, $25,000 for fuel, and $161,000 for cases and miscellaneous packing materials. The total plant investment is in the order of $450,000, and the average age of the facilities is approximately 10 years.

b. Pearl Essence

"Pearl essence," a silvery iridescent material obtained from the belly-scales of the herring, is used in the manufacture of cosmetics. One plant in Eastport accounts for over 90% of the production in Washington County. It is reported that in 1957 this plant consumed 24,500,000 pounds of herring to produce $1,500,000 worth of extract. A small plant in Lubec probably contributed another 5% of product value. These activities provided employment for 20-25 people during the operating season.

c. Smoked Herring

Boneless smoked herring are processed by 8-10 small companies in Washington County. They employ about 150 people on a part-time basis, and the average pay is estimated to be in the order of $300 per year.

d. Other Fisheries

The figures in Table XLIV[1] indicate that herring, clams, and lobsters accounted for 96% of the weight and 98.6% of the value of all landings in Washington County during the period 1952 through 1956.

1. Compiled from federal and state statistics.

TABLE XLIV

WEIGHT AND VALUE OF HERRING, LOBSTER, AND CLAM LANDINGS IN WASHINGTON COUNTY

(Annual Average for 1952 Through 1956 Period)

	Weight (pounds)	Percent	Value	Percent
All fish	49,505,000	--	$2,278,000	--
Herring	42,771,000	86.5	622,292	27.3
Clams	2,178,400	4.4	679,200	29.8
Lobsters	2,454,000	5.1	944,800	41.5
		96.0		98.6

Except for herring, little or no value is added to any other species by on-shore processing in Washington County, and the money paid the fishermen for these species represents the maximum amount of revenue that will flow into the county from outside sources.

The operating facilities in the Passamaquoddy area provide a total of around 1900 jobs, which pay an estimated total of $616,000 per year in wages. A breakdown of these figures is shown in Table XLV.

TABLE XLV

ESTIMATED JOBS AND WAGES FROM PROCESSING OF FISH IN THE PASSAMAQUODDY AREA

Product	Number of Jobs	Annual Wages and Salaries
Sardines	1,436	$170,000
Fish meal and oil	48	64,000
Pet food	115	225,000
Pearl essence	25	36,000
Smoked herring	130	56,000
Can fabrication	125	40,000
Miscellaneous	50	25,000
Total	1,929	$616,000

VI. MINERAL RESOURCES AND INDUSTRY

Mineral production accounts for a very small part of Maine's total output. In recent years the value of minerals produced in the state amounted to less than $13 million per year, or less than 0.1% of the value of the nation's mineral production. Only 0.2% of Maine's employed labor force was engaged in this sector of the economy in 1950.

Maine suffers from very complex geology and inadequate mapping. Only about 20% of the subsurface rocks have been mapped. Bedrock data is very scarce, especially in the northwest. The fact that almost all land is privately owned has been a hindrance to prospecting. The state is currently simplifying its prospecting and mining laws in order to encourage more activity by private operators. The area is completely unfavorable for the occurrence of petroleum and natural gas. There is reason to suspect the presence of base metals, and there are known to be some large, low-grade manganese deposits. Small amounts of some of the rarer, strategic minerals are found in the pegmatites of the west and on the southeastern coast. Thus far, however, almost all of Maine's mineral income is derived from bulky, low per-ton-value materials which cannot economically be shipped very far.

A. BEDROCK GEOLOGY

The rocks exposed in Maine represent parts of the thick sedimentary sequences (now slightly to heavily metamorphosed) deposited during the Paleozoic age and subsequently folded, faulted, and intruded during the Appalachian mountain-building episodes (Late Paleozoic). With the exception of Triassic trap-rock dikes, none of the rocks of Maine are younger than Carboniferous.

For general purposes, two distinct geological subprovinces within the state can be described:

1. Intruded high-grade metamorphic rocks.

   The southern half of the state, roughly south of Waterville (44° 30' and south), consists chiefly of highly folded and contorted schists and gneisses of undetermined age (Late Precambrian through Late Paleozoic) intruded by Paleozoic granitic rocks. At least two

major periods of intrusion are known, giving rise to both metamorphosed and unmetamorphosed igneous rocks. Associated with the granites are many pegmatitic intrusions with major occurrences extending from Paris, Norway, and Newry through Auburn and Topsham.

2. Intruded low-grade metamorphic rocks.

Low- and medium-grade metamorphic rocks considerably less distorted and intruded than those of the southern subprovince occur in northern Maine. The metasediments (slates, quartzites, shales, and sandstones with minor limestone and marble) of Paleozoic age (mostly Silurian and Devonian) have been folded and intruded again by granitic rocks. In this area the granitic intrusions form the resistant Monadnock mountains (Katahdin, Sugarloaf, Mt. Desert, Blue Hill, etc.).

Structurally, the rocks of southern Maine trend northeast, parallel to the general Appalachian trend, which gradually swings to a nearly east-west trend in the easternmost portion of the state. Except for the coastal areas and the Monadnock mountain-forming granites, the structure and lithic character of rocks plays only a minor role in defining the physiography of the state.

B. COMMODITY SURVEY

1. Abrasives

Approximately 500 pounds of low-grade felsite and basalt pebbles was taken from the beaches of Washington and Hancock Counties during World War II for grinding purposes. The area was abandoned because of the inferior grade.

2. Asbestos

Some small showings were recently drilled in the Jim Pond and Little Spencer Stream areas of Franklin and Somerset Counties. There is an indicated 3-5% chrysotile asbestos in extensive masses of serpentine.

3. Base Metals (Copper, Lead, Zinc)

There has been sporadic prospecting and even mining along the coast from Penobscot Bay to Eastport. Before the turn of the century the Douglas mine at Blue Hill, Hancock County, produced more than 2 million pounds of copper, while the Cape Rosier mine shipped 10,000 tons of ore. Both of these mines have been examined by private companies since World War II and found to have little economic potential. This is, however, a base-metal district that cannot be rejected without the use of modern exploration techniques and some diamond drilling. A large company that has done some exploration in the area was planning to drill during the summer of 1958. The Cape Rosier mine may be reopened for examination, and a nickel-cobalt-copper property near Union, Knox County, was recently test-drilled.

Several companies, including Kennecott, Anaconda, American Metal Climax, American Smelting and Refining, Texas-Gulf Sulfur, and New Jersey Zinc, have been exploring for base metals in the general area of Washington and Hancock Counties. The state is surveying much of these two counties by aerial magnetometer and ground magnetometer on a fairly widely spaced basis, primarily to attract private exploration. Interest centers in these two counties because the region contains large granitic masses and lies across the projected trend of rocks from the rich Bathurst - Newcastle district of New Brunswick. The method of reconnaissance is a geochemical and geophysical exploration of the ground approximately one mile on either side of the Devonian - Carboniferous intrusive contacts.

Although nothing has been found to date, the area around Danforth remains the most promising for base-metal discovery. If the exploration programs currently under way are successful, the largest mill that would be built would probably produce 200-300 tons per day. Such an operation would require a capacity of 200-300 kilowatts.

4. Clays

There are various glacial and postglacial argillaceous sedimentary beds along the mouths of rivers in the southeastern part of the state. There are two surface mines in Androscoggin County (major producer, Morin Brick Co.), four surface mines in Cumberland County (major producer, LaChance Bros. Brick Co.), and one surface mine in Penobscot County. Impurities limit the use of these clays to heavy products such as building brick. Some reddish-colored granite and glacial rock flour clays near Calais are suitable for making bricks.

5. Diatomite

Washington County contains small, low-grade deposits.

6. Graphite

Some disseminated deposits are known in Oxford, Franklin, Cumberland, and Sagadahoc Counties.

7. Iron

There has been insignificant production from a limonite and hematite gossan over pyrrhotite in Piscataquis County. This work was not considered encouraging for future development. The Katahdin pyrrhotite deposits in Aroostook County probably would supply a considerable tonnage of sintered iron ore when the recovery of the sulfur in the deposits is warranted, although the sale of sinter poses a problem because of trace amounts of copper, nickel, and cobalt. (See also Pyrites and Pyrrhotite.)

8. Limestone and Dolomite

In the western Penobscot Bay region a five-mile belt of argillaceous limestone of Cambro-Ordovician age trends northeast from Thomaston, Knox County. Reserves are considered to be large. The Dragon Cement Company, of Thomaston, employs a wet process in its two-million-barrel-per-year plant to manufacture general-use and moderate-heat, high-early-strength, and mortar cements. The Rockland-Rockport Lime Co., Inc., of Rockland, Knox County, uses this deposit as a source of quicklime and a high-calcium product for chemicals.

9. Manganese

Three districts in eastern Aroostook County contain large, low-grade manganese ore in complex silicates and carbonates. The northern district west of Presque Isle and Caribou contains 20 deposits, the largest of which shows 26 million tons of ore of 10.4% manganese content. The deposits in the southern district, near Houlton, are smaller and more scattered than those in the north. The Maple Mountain-Hovey district, the largest of the three, lies 21 miles northwest of Houlton. Reserves are said to be on the order of 256 million tons of 8.9% manganese and 20.7% iron. A recent discovery of an iron-manganese outcrop near Greenville, Piscataquis County, appears to be a siliceous deposit similar to the Maple Mountain-Hovey deposits, and it could be an extension of these.

The Aroostook County deposits, the largest in the nation, appear to offer the best promise for an emergency source of manganese. Considerable diamond drilling has been done and extensive laboratory and pilot plant metallurgical investigations have been carried on both by the Bureau of Mines and private industry. Although some encouraging results have been obtained, the processes developed have not resulted in methods to produce manganese at a sufficiently low cost. Research work is continuing.

10. Molybdenum

Small, scattered deposits are known in Aroostook County, near Turk Pond, Hancock County, and Cooper, Washington County.

11. Peat

Large reserves (150 million tons) are known to exist in bogs along the coast in Washington and Hancock Counties. Domestic Peat Co., of Columbia Falls, Maine Peat Moss, Inc., of Jonesport, and American Peat Co., of Deblois, supply peat for horticultural purposes.

12. Pegmatites

Feldspar, quartz, mica, beryl, columbium, tantalum, spodumene, lepidolite, and pollucite occur in pegmatites of Oxford, Sagadahoc, and Androscoggin Counties. Quartz and feldspar are the most abundant minerals. As is characteristic of pegmatite deposits, production has been small.

a. Beryllium

The mineral beryl is found in the pegmatites of Newry, Norway, and Bethel. Major producers are the Whitehall Co., Newry, and William Pechnik, Norway. Nearly all ore (concentrated) is shipped to the Minerals Purchase Department (General Services Administration), Franklin, New Hampshire.

b. Columbium-Tantalum

The columbite-tantalite mineral series occurs in the Topsham and Newry areas. The Whitehall Co., Inc., the major producer, ships all ores to General Services Administration, Franklin, New Hampshire.

c. Feldspar

Potash feldspar (orthoclase-microcline) for use in pottery manufacture and abrasives in heavy-duty cleaners and soaps are taken from 15 active mines: two in Androscoggin County, five in Oxford County, and eight in Sagadahoc County. Major producers are Bell Minerals Co., West Paris, International Minerals and Chemical Co., Topsham, and Topsham Feldspar Co., Topsham (which produces crushed spar for poultry grits).

d. Mica

In Oxford County, 14 active mines produce the mineral muscovite. The Roger W. Wheeler mine near Gilead is the major producer, shipping all ore to General Services Administration, Franklin, New Hampshire.

e. Lithium

The pegmatites near Newry are the source of the mineral spodumene. The Whitehall Co., Inc., is the major producer. Dow Chemical is examining pegmatites near Warren, Knox County, as a source of lithium.

13. Pyrites and Pyrrhotite

The only large deposit is at Katahdin, Piscataquis County. Diamond drilling indicates 4.1 million tons of iron and 2.5 million tons of sulfur. This deposit could be economically developed only if there were a greatly increased demand for sulfuric acid in New England or if the large Gulf sulfur deposit became depleted. Neither of these possibilities seems imminent. (See also Iron.)

14. Sand and Gravel

Sand and gravel are taken from surficial (glacial and alluvial) sedimentary deposits primarily in Cumberland, Penobscot, Aroostook, Androscoggin, and York Counties. Most is used as paving gravel, with a small amount going into building and structural uses. The Maine State Highway Commission is the major producer and consumer.

15. Slate

A large deposit of Silurian slate trends eastward through central Maine from Blanchard to Brownville, Piscataquis County. Four underground mines and a mill are operated by the Portland-Monson Slate Co., of Monson. The deposit is a principal domestic source of switchboard panels and electrical slates.

16. Stone

Granite is quarried in Aroostook, Waldo, Penobscot, Franklin, Washington, Knox, Hancock, and York Counties. Along with sand and limestone, it is used as dimension stone, riprap, concrete aggregate, and road material. The major producer is Deer Island Granite Corporation, Deer Island, Hancock County.

Tables XLVI and XLVII summarize the value and distribution of mineral production in Maine. It is evident from both tables that bulk minerals, notably cement, sand, gravel, and stone, account for most of the value and tonnage of the state's mineral output. The value of mineral production in Washington County is insignificant.

TABLE XLVI

VALUE OF MINERAL PRODUCTION IN MAINE, 1953-54
(By Counties[1])

County	1953 ($)	1954 ($)	Minerals Produced in 1954 in Order of Value
Androscoggin	332,991	374,545	Sand and gravel, feldspar, clays, gem stones
Aroostook	--[2]	81,893	Sand and gravel
Cumberland	296,978	447,354	Stone, sand and gravel, clays
Franklin	8,937	17,046	Sand and gravel
Hancock	519,935	--[2]	Stone, peat, sand and gravel
Kennebec	2,280,776	2,069,983	Sand and gravel, stone
Knox	5,987,004	5,980,241	Cement, stone, lime
Oxford	118,489	110,678	Mica, beryl, feldspar, sand and gravel, gem stones
Penobscot	68,697	229,676	Sand and gravel, stone clays
Piscataquis	--[2]	--[2]	Slate
Sagadahoc	48,078	--[2]	Feldspar, sand and gravel, columbium tantalum concentrate
Somerset	--[2]	--[2]	Sand and gravel
Waldo	--[2]	--[2]	Sand and gravel, stone
Washington	81,164	--[2]	Peat, sand and gravel
York	--[2]	--[2]	Stone, sand and gravel
Undistributed	760,140	1,344,532	Stone, sand and gravel

1. Lincoln County not listed because no production was reported.
2. Listed with "Undistributed."

TABLE XLVII

MINERAL PRODUCTION IN MAINE, 1954-1956[1]

Mineral	1954[2] Short Tons[4]	1954[2] Value in Dollars	1955[3] Short Tons[4]	1955[3] Value in Dollars	1956[3] Short Tons[4]	1956[3] Value in Dollars
Beryllium concentrate	--[5]	--[5]	22	12,671	12	6,696
Cement (376-lb barrels)	1,973,249	5,425,184	2,348,517	6,875,445	--[5]	--[5]
Clays	--[5]	--[5]	32,598	32,598	26,162	23,045
Feldspar (crude long tons)	--[5]	--[5]	26,282	188,961	22,219	143,495
Gems (carats)	--[6]	--[5]	--[6]	5,000	--[6]	500
Lime	--[5]	--[5]	--[5]	--[5]	11,997	179,162
Mica						
Scrap	--[5]	--[5]	71	1,922	114	3,213
Sheet (lb)	--[5]	--[5]	21,121	128,721	19,913	146,437
Sand and gravel	7,460,620	2,538,143	7,528,903	2,855,585	7,196,019	3,085,417
Stone	1,023,709	2,355,709	1,192,361	2,542,228	942,478	2,238,011
Peat	2,350	99,831	--[5]	--[5]	--[5]	--[5]
Undistributed (including columbium tantalum concentrate, and slate)		742,140		857,353		6,912,327
Total		10,656,000[7]		12,991,000[7]		12,179,000[7]

1. Production as measured by mine shipments, sales, or marketable production (including consumption by producers).
2. Minerals Yearbook, 1954, U. S. Bureau of Mines.
3. Personal communication, John Rand, State Geologist, Maine Geological Survey.
4. Short tons unless otherwise specified.
5. Value included with "Undistributed."
6. Quantity not known.
7. Total has been adjusted so that duplication in the value of stone could be eliminated.

C. MINERAL EXPLORATION AND DEVELOPMENT

Maine now employs a full-time geologist within the Department of Economic Development, primarily to develop the state's natural resources. Efforts and aims are as follows:

1. Revision of mineral and mining laws pertaining to state lands.

   Although less than 3% of land area is state-owned, the state recognized the inefficiency and bulkiness of previous mineral laws regarding public land; and on August 23, 1957, Chapter 293 of Public Laws of 1957 went into effect, greatly simplifying the process of claiming, licensing, and mining on public land, which includes 180,011 acres of school lots, 1053 acres of public domain, and some fish and game, military, and great pond areas. The effectiveness of the new law is shown by the very large number of claims filed in late 1957 and early 1958. Although many claims have been filed by individuals, large companies, such as Dow Chemical, Roland F. Beers (Troy, New York), Northern Pyrite Corp. (subsidiary of Texas-Gulf Sulfur Co.), and Penobscot Mining Corp., have also filed.

2. Surveys and mapping parties.

   On February 12, 1958, the state completed an aeromagnetic survey of portions (1000 square miles) of Hancock and Penobscot Counties as the first of a series of geophysical and geological reconnaissance surveys of large areas of Maine. In addition, summer field parties are mapping critical areas in detail, essentially for mineral exploration aid.

3. Miscellaneous activities.

   Major land-holders (paper companies, etc.) have made arrangements for several large mining companies to begin exploration programs in many large areas. The U. S.

Bureau of Mines and several private organizations are studying ways of developing the manganese reserves of Aroostook County, where technical problems involving the milling and refining of very low-grade ore have prevented production.

D. OUTLOOK FOR MAINE'S MINERAL RESOURCES

It is evident that no substantial increase in the value of Maine's mineral output can be expected without new discoveries or developments in sulfur, base metals, and manganese. Neither the bulky, low-value minerals used for construction and road building nor the erratic, small-volume pegmatite minerals are likely to make a significant contribution to the state's economic development. On the basis of present indications, it would take a wartime emergency or an unexpected increase in the price of imported ores to stimulate the utilization of Maine's submarginal deposits.

1. Sulfur

The United States is currently self-sufficient in sulfur, with more than 80% of production being native (Frasch process) sulfur. Only 6% of domestic output came from pyrites in 1955. The large sulfur producers in Louisiana and Texas enjoy a considerably improved reserve-output ratio; the recovery of by-product sulfur from Canada's natural gas wells is increasing; and substantial tonnages of Frasch sulfur are entering the market from Mexico's new deposits. Domestic requirements can therefore be met for the foreseeable future without the exploitation of the 2.5 million tons of pyritic sulfur (less than half a year's U. S. needs) known to exist in Maine's Katahdin Iron Works.

2. Base Metals

Although no major discovery has been made to date, the possibility of finding sizable base-metal deposits cannot be dismissed. Because of the discovery of base metals in the Bathurst-Newcastle district of New Brunswick, exploration is currently under way on an unprecedented scale. The proximity of East Coast refineries and markets provides a spur to private exploration of potential domestic sources of base metals. The intense interest notwithstanding, there is no reason to use base-metal development as a basis for projecting increased mining activity in Maine.

3. Manganese

The possibilities of utilizing Maine's low-grade manganese deposits, beneficiating them by the least expensive route to a high-grade manganese concentrate, and processing them near the mine site are discussed in Part Two (Section II-E). We conclude that, barring a wartime situation, the production of a manganese concentrate from Maine ores would be uneconomical as long as the delivered price of imported ores remains lower than $1.50 per long ton. (The current price is $1.10-1.20.)

In the event that price increases or an emergency should make the United States increasingly dependent on beneficiated domestic manganese, it is likely that the processing of open-hearth slag would be given the highest development priority. It has been estimated that manganese so recovered could eventually supply one-half of the country's current requirements. The process would have the advantage (over a Maine beneficiation operation) of requiring no initial investment in mining facilities and no long-haul transportation of the ore and the concentrate. Nor would it involve any change in present steel-milling practice other than selective dumping of slag.

In summary, there is no presently available evidence on which to forecast any significant change in Maine's mining economy.

VII. MANUFACTURING

A. INTRODUCTION

The growth of manufacturing in Maine is hampered by a set of adverse factors that include paucity of raw materials, distance from markets, the high cost of fuel and power, and the lack of entrepreneurial ability or willingness to incur risks to meet competition from the more aggressively industrializing parts of the country. This is not to imply that existing raw materials have not been adequately utilized. The forest-products industry, based on Maine's extensive timber stands, overshadows all other manufacturing industries in the state. Its growth has been substantial, but its future growth is limited by the quantity and quality of the raw material available. Next in importance among the state's natural resources are its productive farmlands and fishing grounds. Although utilization of these resources has not been maximized, the trend is toward greater efficiency, and growth in some segments of the food-processing industry is expected. Maine's two other major industries--leather and textiles--are there for historical reasons and also to take advantage of prevailing low wage rates. Maine, like the rest of New England, has suffered from a declining textile industry. Textile leaders are uniformly in agreement that the decline will continue. The leather industry in Maine has held its own in the face of an industry-wide decline in New England. In fact, some of the Massachusetts plants have moved to Maine because of the low wage scale and ease of entry. This advantage should continue and will support the state's leather industry despite a trend toward further concentration in other parts of the country.

The concentration of industry close to markets for high-value goods and to raw materials for low-value goods is an accepted fact in the U. S. economy. Manufacturing in the Midwest's industrial belt has grown chiefly at the expense of New England. That other isolated areas have experienced greater economic prosperity than Maine can be explained almost entirely by the availability of raw materials. A most convincing argument can be made if the industrial base of Maine is compared with that of the state of Washington. The raw-material base is roughly the same in both areas--forests and fertile farmlands. In addition, of course, Washington enjoys a plentiful supply of low-cost hydroelectric power. The difference, insofar as raw materials are concerned, lies in the quantity available. Because its forests are more extensive and their stands more valuable, Washington is a significantly more important manufacturing state than Maine, even though transportation costs to the same markets are substantially greater from the Pacific Northwest

than from the Northeast. Even though Washington has the added disadvantage of higher labor costs, it serves a much larger market than Maine. Information about the destination of products made in Maine and Washington (see Figures 13 and 14) is based on data in the Interstate Commerce Commission's "Carload Waybill Statistics" for 1956.

It is thus necessary to conclude that Maine's future as a manufacturing state is based on its: (1) utilization of limited raw materials, (2) serving a local market, and (3) successful competition with areas where labor costs are higher. The first two bases offer some promise of growth, while the latter is merely a temporary and uncertain advantage not in itself conducive to the establishment of a solid industrial economy.

B. FOREST PRODUCTS

By far the most important single element in Maine's economy is its forest-products industry, comprised essentially of lumber and pulp and paper products. In 1956, it accounted directly for 14% of the state's total nonfarm employment. Among manufacturing industries, the forest-products group accounts for almost 40% of the value added by manufacture, about 30% of all production workers, and 35% of gross wages paid.

1. Forest Resources

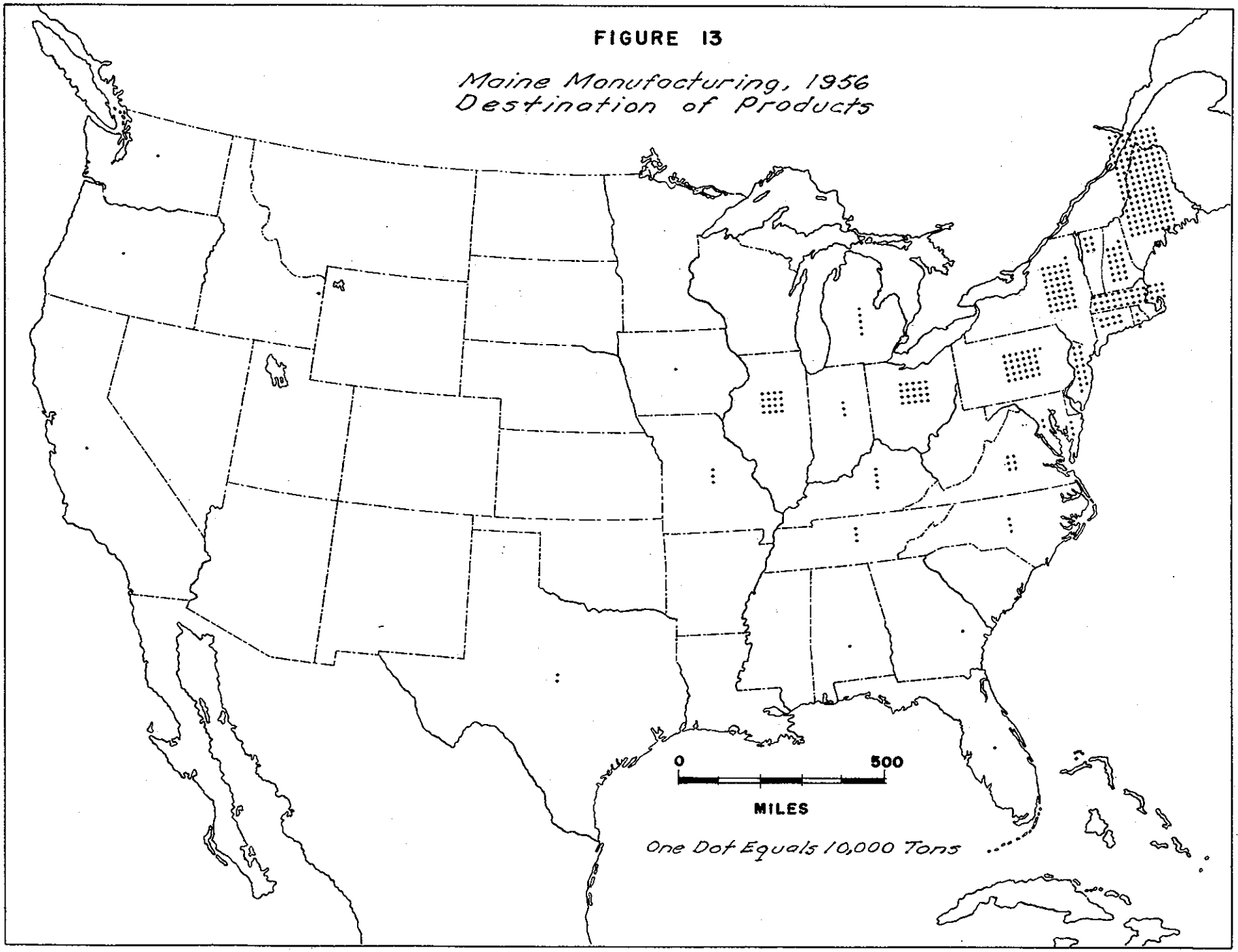
Approximately 16.6 million acres, or 84% of Maine's land area, is classed as commercial forest land. Its ownership is shown in Table XLVIII.

TABLE XLVIII

OWNERSHIP OF MAINE'S COMMERCIAL FOREST LAND
(Acres)

Privately Owned	16,419,000
Wood-using industries	6,617,000
Farm woodlands	2,232,000
Other	7,570,000
Government Owned	182,000
Federal	90,000
State	41,000
County and Municipal	51,000

FIGURE 13


Maine Manufacturing, 1956
Destination of Products
0
500
MILES
One Dot Equals 10,000 Tons

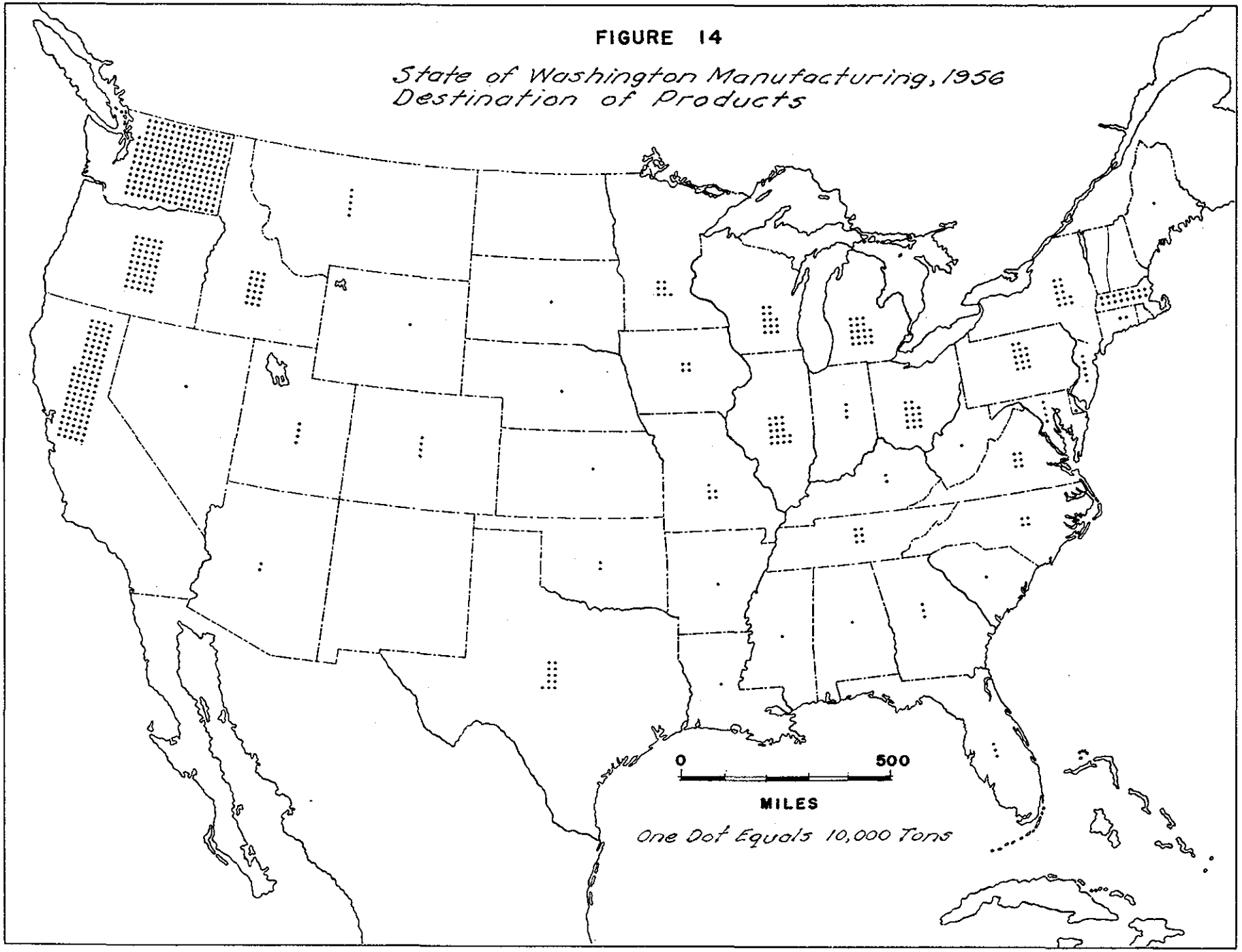


FIGURE 14
State of Washington Manufacturing, 1956
Destination of Products
0
500
MILES
One Dot Equals 10,000 Tons

Of the privately owned portion, 28 enterprises have control of 9.1 million acres, or 55% of the total, in individual holdings exceeding 50,000 acres. These owners are principally the timber and pulp interests and several large estates.

The commercial forests contain in excess of 28 billion board feet of saw timber and almost 13 billion cubic feet of growing stock. (Growing stock is used for pulping.) The magnitude of the state's forest resources is shown in Table XLIX. Table L shows the current utilization of Maine's commercial forests by species.

It may be noted that softwood saw timber and growing stock are both being harvested more rapidly than they are being replaced. On the other hand, the contrary is true for the hardwood species. Forestry authorities recommend two distinct steps to perpetuate Maine's forest resources: (1) improved management practices in the use of softwoods; and (2) greater utilization of the hardwood stands.

The estimated forest resource of Washington County is:

Species	Volume (Thousands)
Spruce and fir 6 inches and up	3,900 cords
Hemlock	600 cords
Hardwood pulpwood	2,000 cords
White and red pine	400,000 board feet
Cedar	85,000 board feet

Source: Maine Forest Service

2. Characteristics of the Industry

Maine's forest-products industries fall into two broad classifications: logging and lumbering, and pulp and paper manufacture. The development of the industry as a whole as well as its principal components is detailed in Table LI. It is evident from this table that the pulp and paper segment is the more important of Maine's forest products. This is true to an even greater extent than the statistics indicate because logging, which is common to both segments of the industry, is included in the lumbering and wood-products group.

During the past eight years, however, the lumber-products group has expanded much more rapidly than the higher-value pulp and paper segment. A comparison between Maine and the nation is given in Table LII.

TABLE XLIX

MAINE'S ESTIMATED TIMBER RESOURCES

Saw Timber Volume by Species

	Million Board Feet	Percent of Total
Total Saw Timber	28,200	100
Softwoods	16,900	60
Spruce and Balsam Fir	11,600	41
White and Red Pine	3,100	11
Hemlock	1,100	4
Other Species	1,100	4
Hardwoods	11,300	40
Yellow Birch and Sugar Maple	6,200	22
Soft Maple and Beech	300	1
Cottonwood and Aspen	300	1
Other Species	4,500	16

Growing Stock Volume

	Million Cu. Ft.	Million Cords	% of Total
Total Growing Stock*	12,600	157	100
Softwoods	5,800	73	47
Hardwoods	6,800	84	53

* Pulp is made from growing stock.

Source: Maine Forest Service

TABLE L

ESTIMATED GROWTH AND UTILIZATION OF MAINE'S COMMERCIAL FORESTS

	Gross Growth	Mortality	Harvested for Use	Balance
Saw Timber (Million Bd. Ft.)	1,220	410	1,030	-210
Softwoods	590	130	860	-400
Hardwoods	630	280	170	+190
Growing Stock (Million Cu. Ft.)	570	190	290	+ 90
Softwoods	190	40	230	- 80
Hardwoods	380	150	60	+170

Source: Maine Forest Service

TABLE LI

DEVELOPMENT OF THE FOREST-PRODUCTS INDUSTRY IN MAINE

	Value of Product (thousands of dollars)			Number of Workers			Gross Wages Paid (thousands of dollars)		
	1949	1957	% Change	1949	1957	% Change	1949	1957	% Change
All Forest Products	268,900	516,800	92.2	27,700	31,500	13.6	67,700	124,700	83.9
Lumber and Wood Products	62,800	135,300	115.4	11,300	13,900	23.6	19,700	42,300	115.0
Paper, Pulp and Allied Products	206,100	381,500	85.0	16,400	17,500	6.7	48,100	82,400	71.3

Source: Census of Maine Manufactures, 1949-1957, State Department of Labor and Industry.

TABLE LII

COMPARATIVE GROWTH OF FOREST-PRODUCTS INDUSTRY IN MAINE AND THE UNITED STATES

	Value of Product (% Change 1949-56)		Production Workers (% Change 1949-56)		Gross Wages Paid (% Change 1949-56)	
	Maine	U. S. A.	Maine	U. S. A.	Maine	U. S. A.
All Forest Products	100.5	81.0	22.7	11.7	91.8	67.4
Lumber and Wood Products	128.6	60.0	46.9	5.0	147.7	56.0
Paper, Pulp and Allied Products	91.9	98.4	6.0	22.3	68.9	80.2

Source: Maine data based on Census of Maine Manufactures - 1949 and 1956, State Department of Labor and Industry; U. S. data based on U. S. Census of Manufactures - 1949 and U. S. Survey of Manufactures, 1956.

As a group, the forest-products industries have expanded much more rapidly in Maine than in the nation as a whole. In Maine, however, the growth of the component industries shows two noteworthy deviations from the national pattern: (a) Maine's lumber and wood products have grown more rapidly than pulp and paper, whereas nationally the opposite is true; and (b) the increase in the number of production workers in Maine's pulp and paper group is substantially smaller than that in the nation's. This latter circumstance is a reflection of the recent emphasis on the development of the state's pulp mills, which characteristically have comparatively low employment requirements.

Despite the comparatively rapid expansion of Maine's forest-products industries, the state's rank in value of products was virtually unchanged in 1949 and 1956.

TABLE LIII

VALUE OF MAINE'S FOREST PRODUCTS AS PERCENTAGES OF UNITED STATES

	1949	1956
All Forest Products	1.9	1.7
Lumber and wood products	2.7	2.5
Paper, pulp and allied products	1.3	1.4

a. Lumber

Maine is one of the country's three leading producers of white pine, which comprises more than half of the state's lumber output. The state is primarily a softwood producer; however, the extensive stands of hardwood timber in the northern half of the state are becoming a more important segment of the lumber industry. Maine's 1956 lumber production is shown in Table LIV.

The state's lumber industry reached its peak early in the century, with an annual production in excess of 1 billion board feet. Production continued at high levels through the 1920's, then gradually declined to 200-300 million board feet during the 1930's. Since 1940 it has been increasing, largely because of the exploitation of hardwood stands. It now appears to have stabilized at an annual rate of some 500 million board feet.

While the industry as a whole gives evidence of stability, it is important to note two important long-term developments which have been recognized by the industry:

(1) Softwood production is declining, partly because the better grades of white pine are being exhausted, and partly because a growing proportion of Maine's forests is being oriented to the rapidly growing pulp and paper industry; and

(2) The gradual development of the hardwood resource is taking up the slack in softwood production.

b. Pulp and Paper

As a producer of pulp, Maine ranks fifth among states. The annual production is about 1.5 million tons. In paper and paperboard production, the state ranks seventh, with a yearly output of some 1.6 million tons. A high proportion of Maine's pulp is used in the manufacture of kraft in the western part of the state. The pulp requirements for these paper mills are entirely satisfied by state sources. (High-grade Scandinavian pulp is imported through Maine ports, then transhipped to fine-paper mills elsewhere in New England to satisfy their qualitative requirements.)

TABLE LIV

MAINE'S LUMBER PRODUCTION, 1956
(Board Feet)

Softwood Lumber	425,900,000
White Pine	261,500,000
Hemlock	70,100,000
Spruce	63,700,000
Cedar	12,700,000
Fir	8,200,000
Norway Pine	5,000,000
Pitch Pine	3,400,000
Other	1,300,000
Hardwood Lumber	124,300,000
Birch	78,600,000
Maple	19,800,000
Beech	8,500,000
Oak	5,500,000
Ash	3,500,000
Basswood	1,400,000
Poplar	1,100,000
Other	5,900,000

Source: Maine Forest Service.

As noted previously, the long-term trend in Maine's forest-products industry is for greater emphasis on the pulp and paper industry, primarily because of the higher value of product. In a very real sense, this segment of the forest-products industry competes with lumbering for the softwood growth.

c. Other Forest Products

Among the state's remaining forest products, Christmas trees probably are most important; the annual harvest is one million trees, valued at $500,000. Because of improved marketing methods and cutting practices, this segment of the industry appears to be growing.

A comparatively small amount of timber is used for veneer logs, toothpicks, twining products, barrels, and shingles. Mill waste finds an important use in wood flour for plastics.

3. Production in Washington County

The county's contribution to Maine's forest-products industry is modest and commensurate with its share of the state's forest resource. The principal product is lumber. (See Table LV.)

TABLE LV

LUMBER AND PULPWOOD PRODUCTION OF MAINE AND WASHINGTON COUNTY, 1956

	Maine	Washington County	Washington County as a % of Maine
Lumber (board feet)	550,200,000	28,100,000	5.1
Softwoods	425,900,000	25,300,000	5.9
Hardwoods	124,300,000	2,800,000	2.3
Pulpwood (cords)	2,700,000	166,000	6.1
Softwoods	2,100,000	159,000	7.6
Hardwoods	600,000	7,000	1.2

Source: Maine Forest Service.

a. Lumber

Of the 24 lumber mills in the county, three are large. A comparison of the county's basic resource and the annual production indicates that timber is being cut more rapidly than it is being replaced.

b. Pulp and Paper

Several of the state's pulp producers own large tracts of timber in Washington County; consequently, most of the wood pulp is presently being shipped out of the county for manufacture into pulp. The only pulp and paper producer in Washington County is St. Croix Paper Company. The company, however, obtains only a small portion of its pulp requirement from county sources; the remainder is imported from Canada.

c. Other Products

The growing and harvesting of Christmas trees on a modest scale comprises the remainder of Washington County's forest-products industry.

4. The Outlook for Maine

The national demand for forest products is expected to expand at a rate slower than that during recent years, but at a pace somewhat more rapid than population growth. The degree to which Maine will participate in the market's growth will depend on the extent to which improved timber-management practices are introduced, and the extent to which the hardwood resource is developed. Because the effects of improved cutting practices will not be felt immediately, the hardwood stands will have to be vigorously developed if Maine is to maintain its present national position during the next two decades.

a. Lumber

It is expected that the volume of softwood lumber will decrease because: (1) many of the state's forest areas are becoming oriented to the pulp industry; and (2) softwood saw timber is being used more rapidly than it can be replaced. The total cut, however, should remain at or near the present level because of the increased use of hardwoods.

By diversifying into the manufacture of mill work, the industry might be able to raise the value of product and increase employment slightly.

b. Pulp and Paper

The present expansion rate of the pulp and paper industry will probably level off appreciably during the next several years. Maine's pulp and paper industry is expected to keep pace with, but not exceed, the national rate of expansion. Industry spokesmen believe that Maine's timber resources are adequate to support gradually increased demands. However, this belief presupposes that the growth of softwoods will be increased, and that the use of hardwoods will be substantially expanded.

Only one new pulp mill seems likely to be built between now and 1970. It would utilize hardwood exclusively and be located in the northern half of the state.

c. Other Forest Products

Maine's output of hardwood veneer logs will probably increase slightly. As more hardwood areas are opened for lumber and pulp use, the logging of hardwood veneer logs will become more economical.

The Maine Christmas Tree Association, by continuing to improve growing, grading, and marketing practices, can greatly increase the state's share of the market. Such action, however, will not result in any increase in employment, because the Christmas tree is essentially an off-season farm crop.

The remaining forest products as a group are not expected to expand. However, anticipated declines in such small industries as barrels and toothpicks will probably be offset by intensified production of other industries, such as wood flour.

5. The Outlook for Washington County

a. Lumber

It is doubtful whether the present level of pine-lumber production can be sustained even with the adoption of improved forest-management methods. However, it is likely that any future decrease in softwood production will be offset by increased use of the county's hardwoods. Washington County's best prospect is simply to maintain the present level of production.

b. Pulp and Paper

The cutting of pulpwood is expected to increase; however, as is presently the case, most of the county's ouput of pulpwood will continue to be shipped to pulp producers elsewhere in the state. The fact that the greater part of Washington County's pulpwood stands are now owned by pulp producers precludes the possibility of any new operation within the county.

c. Other Products

Washington County is well suited to Christmas tree growing. This activity might employ numerous farmers desirous of winter employment. It is expected that the Maine Christmas Tree Association will have better than average success in increasing Washington County's Christmas tree harvest during future years. A sizable increase in the county's production will necessitate the installation of cold-storage facilities. The effect of these developments upon employment, however, will be negligible.

6. Potential Effects of Passamaquoddy Power on Forest-Products Industries

Forest-products industries, with the exception of pulp and paper, are not large power users. Timber is the principal locational requirement, and cheap power alone cannot attract pulp and paper operations if the raw material is not readily available. The combination of adequate supplies of raw material and low-cost power are, of course, ideal for the industry.

As an alternative to the purchasing of power, the pulp and paper industry often generates electricity from process steam if the economics of a given situation warrant such action. The recent experience of the Great Northern Paper Company indicates that electric power can be generated from its own process steam for 2.5 mills per kilowatt-hour.

Despite Washington County's pulpwood resource, it is doubtful that any pulp and paper manufacturers would transfer existing operations to the county even if power were available at a rate of 2.5 mills per kilowatt-hour. The pattern of ownership of timber lands in Washington County precludes any new producer from establishing operations based on the county's timber resource. Consequently, the potential availability of power at Passamaquoddy, even at 2.5 mills, would have no effect upon the industry.

C. TEXTILES

New England's textile industry has declined from a position of major importance to one of minor significance in terms of employment and value added by manufacture. In Maine, the industry's decline, which has closely paralleled that in the rest of New England, has been particularly severe during the past four years. Nevertheless, it is still significant in the industrial structure of Maine and, to a lesser extent, in other parts of New England. In 1956, textile-mill products accounted for 15.5% of the product value of Maine manufacturing and for 15.8% of the total manufacturing employment. Textile manufacturing in Maine ranks second in value of product, although the manufacture of paper and paper products is approximately 85% larger. The textile industry is the state's third largest employer in terms of number of employees and wages paid; it is exceeded only by the leather and paper industries.

Although the textile industry is still of major importance in Maine, during the past decade it has declined markedly in both relative and absolute terms. Textile-mill employment decreased from 25,810 workers in 1947 to 15,648 in 1957, a decrease of 39.5%. During the same period, total textile employment in the United States decreased only 15.5%, while in the eight South Atlantic states, it actually increased 6.5% from 1947 to 1956. The value added by textile manufacturing in Maine decreased 35% during this period, while it remained almost constant in the nation as a whole.

The major difficulties of the New England textile industry and the reasons for its departure to more favorable areas has often been discussed. The customary reasons given for the industry's decline in New England are high wages, low work loads, heavy taxes, obsolescent plants and equipment, high power costs, subsidies in regions seeking new industries, and the over-all decline of demand for textile workers.

1. Wages

The years of greatest decline in New England textile production were those immediately following World War II. The spread between Southern and Northern textile wages offered greater impetus for relocation in the South than it currently does. A comparison made in testimony before the Tobey Committee, of the U. S. Senate, in 1948 indicated a 10% spread in take-home pay between Southern and Northern New England textile workers, and a difference of 58.5% in fringe-benefit payments.[1] A recent survey of textile wages by the Bureau of Labor Statistics of the U. S. Department of Labor indicates a narrower spread as of September 1957 for mill workers in woolen and worsted textiles. In this category, 50% of all workers are in New England mills and 26% in Southern mills. However, the number of New England woolen mills decreases each year, while the number of Southern woolen mills shows a corresponding increase. The industry's average hourly earnings and percentage variation from the national average were:

U. S.	$1.48	--
Southeast	1.32	-11%
New England	1.51	+ 2%
Northern New England	1.44	- 3%

This survey indicated that the average wages in Northern New England (Maine, Vermont, and New Hampshire) were 9% above those in Southern mills, and that New England's average wages were 12% higher than those in Southern mills. A similar survey in April, 1946, indicated that the average wage in New England mills was 23% higher than that in Southern mills. Moreover, the variance in fringe benefits between Southern and New England mills is still substantial.

1. Hearings of Senate Subcommittee of Interstate and Foreign Commerce on Investigations of Closing Nashua, N.H., Mills. Part I (1948), pp. 27-35.

Recent statistics on comparable cotton and synthetic textile mill wage levels are not available, but 1956 wage levels for all textile mills point out the following spread in average hourly wages between Northern and Southern mills:

U. S.	$1.47
New England	1.61
Maine	1.46
South Atlantic	1.38
Georgia	1.32

The most recently published study of the Bureau of Labor Statistics of the U. S. Department of Labor compared cotton and synthetic textile mill wages for November 1954. The regional comparison of average hourly earnings is as follows:

U. S.	$1.26
New England	1.35
Maine	1.32
Southeast	1.22

2. Productivity

Productivity is as important as wage level; thus, higher New England wages are not necessarily a handicap if they are offset by higher output per man-hour. Testimony before the Tobey Committee also pointed out evidence of consistently higher productivity in Southern mills. Few accurate measures of general productivity can be used for comparative purposes. One reference giving some insight to variations in productivity is a comparison of the value added per man-hour of production labor. This comparison for textile mills in 1956, calculated from the 1956 Annual Survey of Manufacturers, is as follows:

U. S.	$2.92
New England	3.11
Maine	2.58
South Atlantic	2.59

The comparison indicates that New England labor, as a whole, had higher output per man-hour than the national average. Maine, however, had a lower productivity rate than the national and Southern average.

Productivity depends on such factors as amount of skilled labor required, management, size of plant, work loads, and use of capital. Two of the South's important advantages are newer and more efficient plant and equipment, and higher work loads. Not only are there more new plants in the South, but industry leaders have testified that management in Southern plants applies technological improvements quicker than its counterpart in Northern mills.[2] New England textile workers have been characterized as rigid in their refusal to accept new work loads, even when a rise in load is consistent with the output of less energy.[3] A survey of comparative work assignments in 21 Southern mills, compared to like assignments in New England mills, was made by a firm of textile engineers and submitted to the 1950 Special Commission on the Textile Industry of Massachusetts. It reported the following variance in machines tended per worker:

	North	South
Pickers	2 to 7	2 to 9
Cards	18 to 26	24 to 52
Drawing deliveries	18 to 36	18 to 48
Combing deliveries	6 to 8	6 to 12
Roving frames	2 to 3	2 to 6
Spinning frames	8 to 20	8 to 26
Looms X-2	24 to 36	24 to 72
Looms	8 to 12	12 to 18

These lower work loads, leading to lower productivity, have undoubtedly had a part in motivating textile companies to move South.

---

2. See, for example, Seymour Harris, The Economics of New England, Cambridge, Harvard University Press (1952), pp. 293-295.
3. Cotton and Rayon Textile Mills of Massachusetts, a report to the 1950 Special Commission on the Textile Industry of Massachusetts (1950), pp. 7-8.

In addition to wage and productivity problems, textile manufacturers have cited heavy taxes, high power costs, and subsidies offered by other regions as major reasons behind the Southern movement. The tax system in Southern states is so constructed that the greatest incidence of taxation falls on individuals rather than industry. Conversely, in New England, heavy property taxes and corporate income taxes shift the burden of taxation to industry.

It can be concluded that the textile industry has moved from Maine and New England to the South because of the attraction of lower-cost production. Table LVI compares costs in New England and the South. It was compiled from a cost comparison introduced in the hearings of the Subcommittee on Interstate and Foreign Commerce by a company which had closed Northern mills and opened Southern mills.[4]

TABLE LVI

COMPARISON OF TEXTILE PRODUCTION COSTS IN NEW ENGLAND AND THE SOUTH

	New England	South
Power (kwh)	14.7*	6.9*
Transportation of raw cotton (¢/cwt)	90	30
Compensation insurance (R.I. = 100)	100	44
Payroll taxes (R.I. = 100)	100	73
Fixed tax per spindle (¢)	253	43
Take-home pay (South = 100)	110	100
Productivity as measured by output of muslin sheeting (lb)	5.37	9.62

* Average of two New England and three Southern mills.

4. Hearings, Subcommittee on Interstate and Foreign Commerce, Part I, Investigation of Closing of Nashua, N.H., Mills (1948) pp. 12-35.

3. Employment

Maine, as a textile producer, has suffered similarly with the five other New England states. Figures 15, 16, and 17 graphically illustrate the region's decline in textiles during the past decade. The declining importance of the textile industry as an employer is indicated by the comparison in Table LVII.

TABLE LVII

TEXTILE EMPLOYEES AS A PERCENTAGE OF TOTAL MANUFACTURING EMPLOYEES IN MAINE AND IN NEW ENGLAND

	New England	Maine
1947	19.1%	25.8%
1949	18.2	28.2
1950	18.7	24.7
1951	16.7	23.1
1952	14.8	21.3
1953	13.9	19.9
1954	11.6	18.4
1955	11.3	16.4
1956	10.8	15.7
1957	9.6	14.9

The present status of the industry in Maine is characterized by a declining number of old established producers. Each year, as additional plants are closed, the textile industry becomes less important within the state.

The year 1957 saw even further decline. Whereas 73 textile mills, employing 17,186 workers, produced goods selling for $214,581,667 in 1956 (see Table LVIII), approximately the same number of mills employing 15,648 workers, produced goods valued at $201,190,631 in 1957. This represents a 9% decrease in employment and a 6% decrease in value of product. Cotton, silk, and synthetic-fiber mill products accounted for 43% of the production in 1956 and 41% in 1957, while woolen and worsted production was 39% of total production in 1956 and 38% in 1957. The woven woolen mills are predominantly all old plants in the northern counties. In general, they suffer from a high degree of obsolescence and a lack of efficiency. Most of the remaining woolen mills either manufacture heavy goods such as uniform materials and army blankets, or are specialty outlets making woolen labels or narrow woolen fabrics.

FIGURE 15

Textile Mill Employment

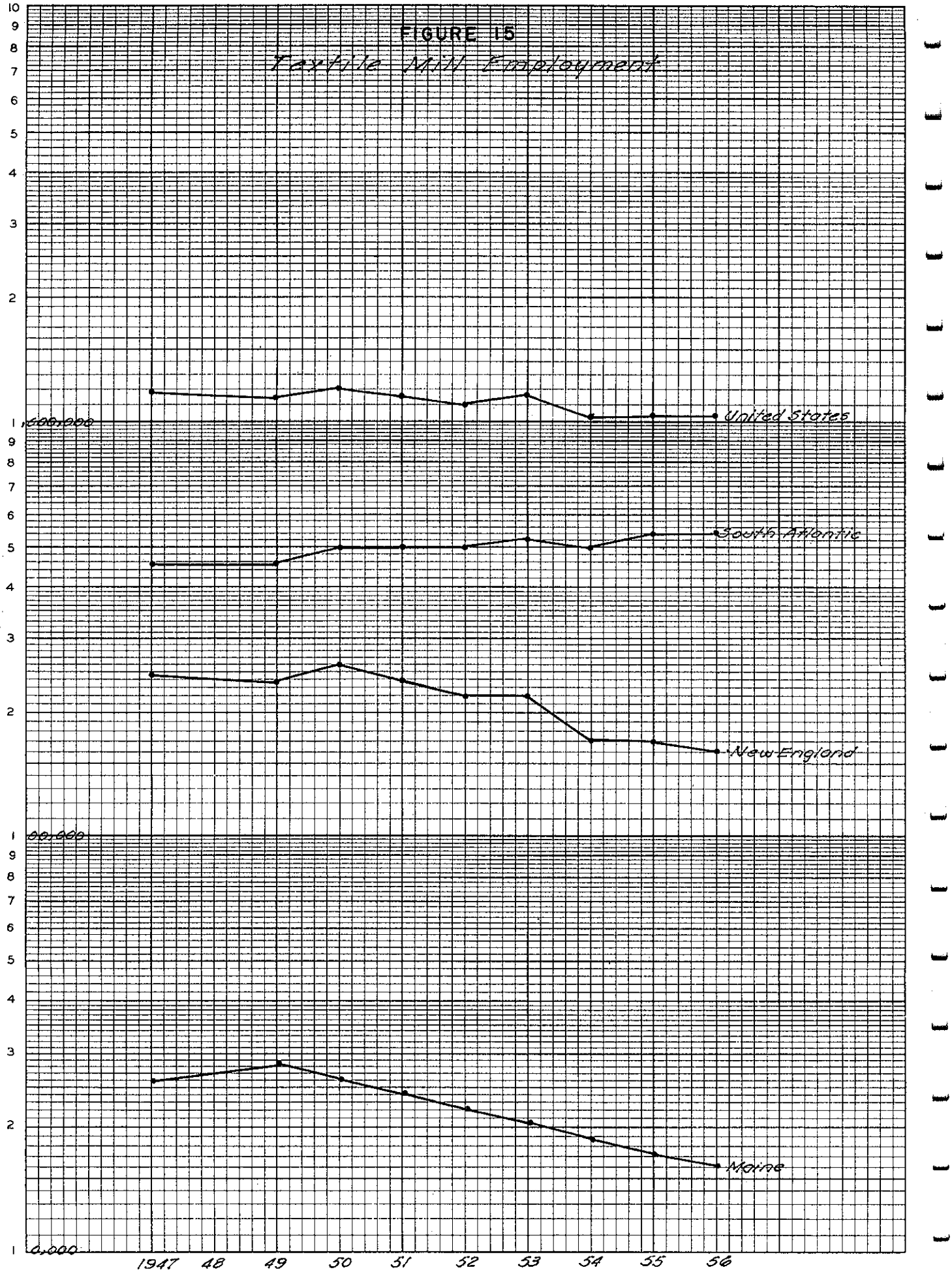


FIGURE 16

Textile Mill Payrolls

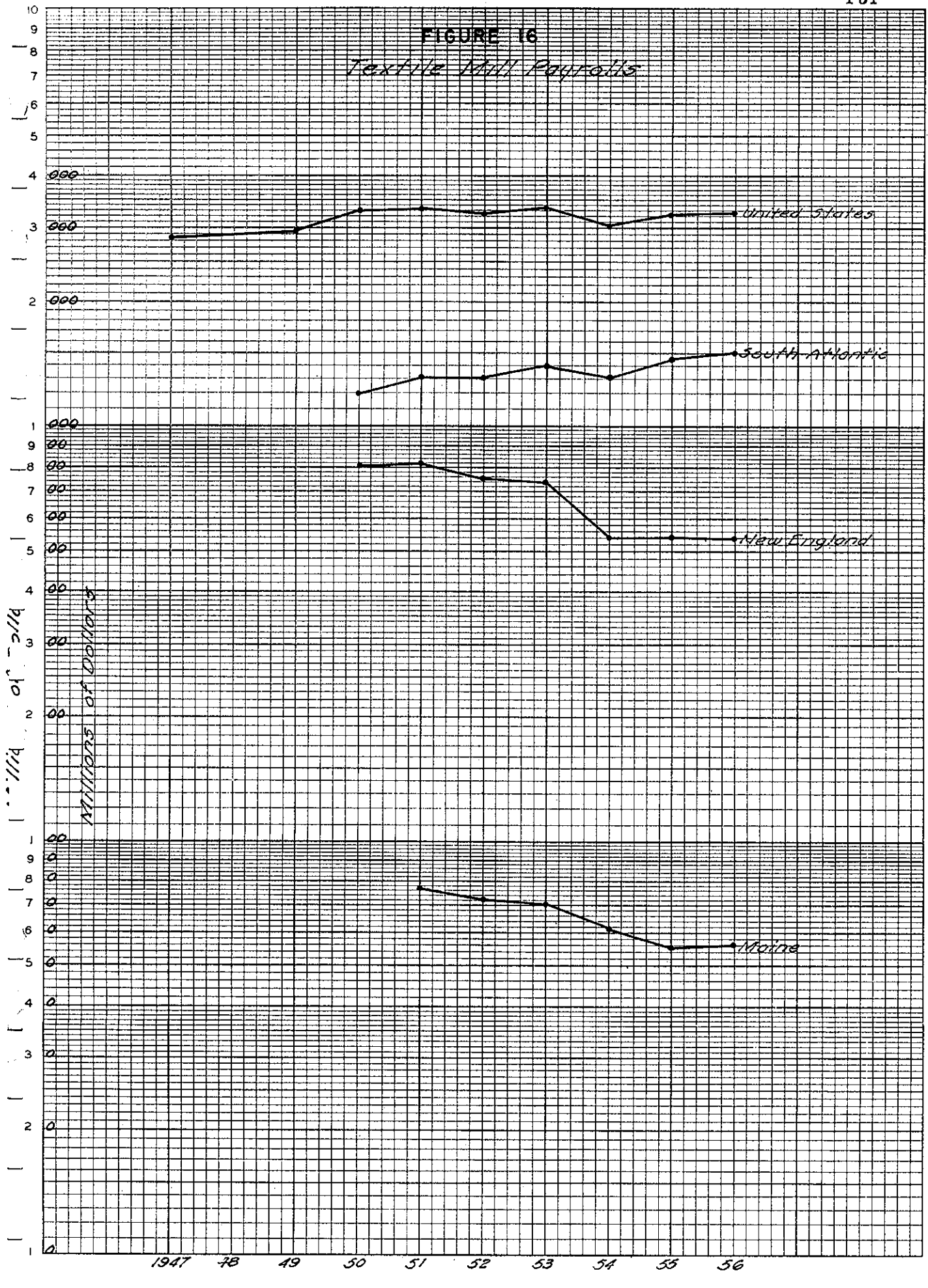


FIGURE 17

Value Added by Manufacture
Textile Mill Products

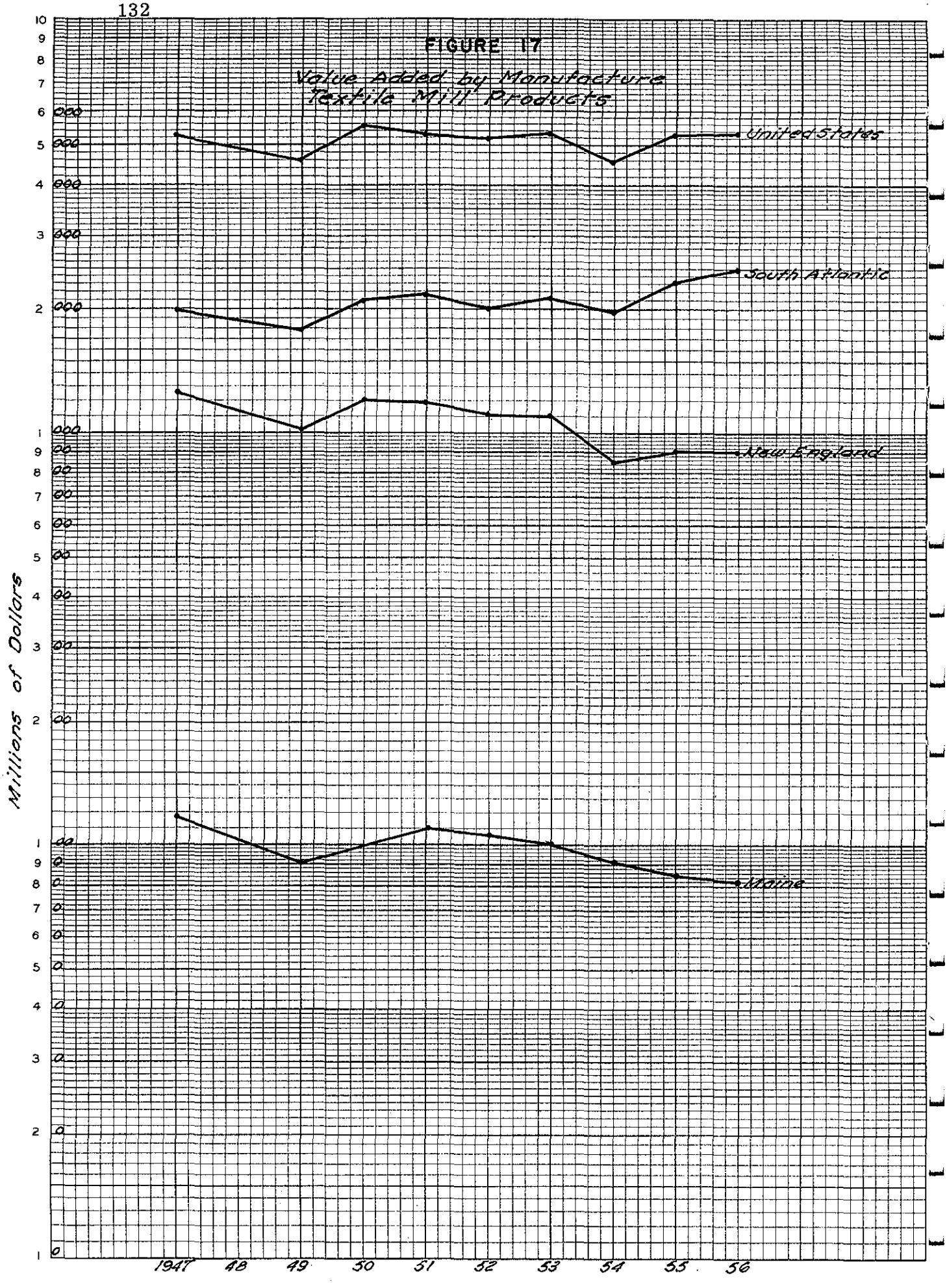


TABLE LVIII

TEXTILE MILL PRODUCTS BY COUNTY

County	Value of Product	Gross Wages Paid	Average Gross Wages	Number of Workers		
				Total	Male	Female
TOTAL	$214,581,667	$52,935,755	$3,080	17,186	10,237	6,949
Androscoggin	66,468,016	19,039,339	3,075	6,191	3,686	2,505
Cumberland	5,434,851	1,217,575	2,591	470	203	267
Franklin	1,973,819	694,631	2,894	240	186	54
Kennebec	32,468,506	8,194,478	3,319	2,469	1,734	735
Knox	3,912,896	1,250,179	2,809	445	278	167
Penobscot	29,255,376	4,099,969	3,069	1,336	953	383
Somerset	13,487,993	2,937,216	2,695	1,090	586	504
York	45,572,922	12,186,799	3,129	3,895	1,961	1,934
All Others	16,007,288	3,315,569	3,158	1,050	650	400

Source: Census of Maine Manufactures - 1956.

The remaining cotton mills are located predominantly in the southern counties. The decline in the number of mills during the past four years has been substantial. In 1954, one of the largest producers, Goodall-Sanford Company, closed all of its Maine mills. In 1957, the largest manufacturer, Bates Manufacturing Company, closed two of its five Maine mills and decreased its working force from 7000 to 5200.

The textile industry has become significant in Washington County during the past decade. The Machias Mill, Inc., a successor of the Textron operation, manufactures rayon and acetate cloth at Machias. This mill, started in 1949, employs 75-100 workers. Willard Mills, at Eastport, was started in 1954; in 1957, it employed an average of 150-200 workers. This mill is a branch of the larger Guilford Woolen Mills, at Guilford, and manufactures wool and wool-blended cloth. There are no other textile manufacturers in the county. Location of the two mills in Washington County was primarily based on the attraction of low-cost labor. The average gross wage for textile workers in Maine was $3156 in 1957. For Washington County, the average was $2928. This spread in wages is not, however, sufficiently great to attract other mills, especially when compared with wage levels at Southern mills.

4. Prospects

The opinion is widely held that the growth of Southern textile mills will continue at the expense of the Maine and New England textile industry.[5] It is reasonable to assume, however, that a segment of the industry will remain, although on a much smaller basis than at present. Two factors militate against the complete removal of the textile industry from New England: (a) Because Boston is expected to remain a principal wool center, some woolen mills will remain in the area to obtain proximity to the raw-material market; and (b) because of prevailing low wages, a significant part of the apparel industry has moved into such centers as New Bedford, Fall River, and Boston. A limited number of cotton and synthetic fiber mills to supply this market can be expected to survive. In view of the competition from newer, efficient Southern mills, it seems clear that only those few New England mills that have been responsive to technological improvements and retained earnings to maintain and improve plants will survive. An increasingly smaller core of Maine mills has been able to meet Southern competition. It seems likely that some of these mills will remain a part of Maine's industrial structure.

---

5. See, for example, Harris, op. cit., Ch. 26.

D. LEATHER AND LEATHER PRODUCTS

Over 90% of Maine's leather and leather-products industries is accounted for by shoe manufacturing, one of Maine's four leading manufacturing industries. In 1957 it ranked first in total employment, second in gross wages paid, and fourth in value of product.

Compared with that of other leading Maine industries, value added from shoe manufacturing has shown a very modest gain during the seven years ending with 1954. However, compared with shoe manufacturing in the United States as a whole, the shoe industry in Maine can be characterized as a growth industry, as is evident from the following tabulation:

Shoe Manufacturing - Maine and United States, 1947-1954

	Percentage Change 1947-1954	
	Maine	U. S.
Value Added by Manufacture	68	25
Total Employment	26	- 4

Source: Census of Manufactures.

As the result of these changes, Maine's relative position in the U. S. shoe industry rose.

Maine's Position in Shoe Manufacturing

	Maine as a Percentage of U. S.	
	1947	1954
Value added by Manufacture	5	7
Employment	6	8

Source: Census of Manufactures.

The national decline in employment is symptomatic of two developments: (1) the trend toward narrowing the industry base (in 1947, 1500 establishments employed an average of 147 production workers each; by 1954, 1369 establishments employed an average of 153 workers each); and (2) the trend toward automation.

The growth of the industry in Maine, in contrast to the national decline, is chiefly the result of the following developments:

1. In their efforts to reduce labor costs, manufacturers have been moving into Maine, where industrial unionization is weak. In 1956, only 22.8% of Maine's leather workers belonged to labor unions. In April of 1957 and 1958, the following hourly wage scales prevailed:

	1957	1958
U. S.	$1.49	$1.52
New England	1.57	1.62
Maine	1.47	1.48

Source: Bureau of Labor Statistics.

2. Maine producers specialize in high-volume, low-priced women's shoes. Industry spokesmen estimate that women's shoes characteristically account for about 46% of total production.

3. The state's shoe industry is composed of about 125 comparatively small operations. Because of the low capital cost involved in the setting up of new plants, and the fact that small operators tend to move in and out of the industry with comparative ease, the state's shoe-manufacturing structure is dynamic but relatively unstable.

The implications of present trends on the future of Maine's shoe industry are for limited growth. Whatever the virtues of independence, the larger, consolidated operations, to which the industry is tending nationally, are more stable, more efficient, and hence, more profitable than Maine's smaller ones.

This potentially depressing circumstance is presently balanced by Maine's lower wage scales. Experience in other areas and in other industries has shown that labor differentials are a transitory advantage at best.

Finally, although Maine's shoe industry is specializing on what is presently the largest segment of the market, it is not concentrating on what will be the fastest-growing segment of the future; namely, children's shoes.

The potential availability of power at Passamaquoddy is a negligible factor in the outlook of the industry. It is estimated that the factory price of the average type of shoe produced in Maine is $2.00-2.85 per pair: the total average cost of heat, light, power, and water runs about 2.2¢ per pair.

E. FOOD PRODUCTS

The manufacturing of food products has consistently been of major importance in the industrial structure of Maine and Washington County. An indication of its importance as an employer is shown in Table LIX.

TABLE LIX

EMPLOYMENT IN FOOD-PRODUCTS INDUSTRY IN MAINE

Year	Total Manufacturing Employment	Employment in Food-Products Industry	Percentage of Total Manufacturing Employment
1957	104,717	9,476	9.5
1956	109,340	10,198	9.3
1955	107,809	9,117	8.4
1954	106,000	10,400	9.8
1953	114,300	10,900	9.5

Source: Census of Maine Manufactures, 1957, 1956. (Note: employment figures reported in Census of Maine Manufactures differ appreciably from those in the Annual Survey of Manufacturers, published by the U. S. Department of Commerce.)

The importance of this industry follows from the state's significance as an agricultural and fishing producer. Of particular importance during recent years is the growth of poultry dressing and packing. This growth has been concentrated primarily in Waldo and Kennebec Counties. Maine's poultry production increased 47% from 1950 to 1955 and is expected to experience continued moderate growth. Consequently, poultry processing has become the most important segment of Maine's food-processing industry in terms of value of product, accounting for 23% of the total for the industry in 1956.

In terms of employment, sea-food packing has the largest number of workers, accounting for 21% of the total in 1956. Sea-food packing is highly seasonal; hence, total wages paid by this segment of the industry are relatively low. In addition, over 60% of the sea-food-packing workers are female; this tends to deflate the average wage level.

Other important segments of Maine's food-processing industry are the bakery and the frozen-food industries. Maine's frozen-food industry, particularly blueberries, has grown substantially during recent years. Table LX presents a breakdown of the food-products industry by subordinate components for 1956.

It is significant that two of the larger components of Maine's food-products industry--poultry processing and frozen foods--are expected to experience further growth. This growth is forecast to be sufficient to offset the expected continuation of the decline in the fish-canning industry. Predominantly all of the other components of the food-processing industry are based on serving a local demand; hence, their growth will be in direct proportion to population changes. Our population projections (see Section I-C) forecast a modest but continuous growth during the study period. This growth will be reflected in a corresponding growth in the food-products segment that serves the local market. In 1956, approximately 40% of the value of product and 34% of the number of workers were represented by the segment that serves a local market. More detailed information on specific components is set out in Section III.

Two other aspects, which are related to each other, are of significance in a consideration of the impetus of the food-processing industry on Maine's industrial structure. First, the industry is a major employer of female workers. Female workers accounted for 42% of those employed in the industry in 1956, and 41% in 1957. The percentage of females working in all manufacturing industries in Maine was 30% in both 1956 and 1957. Two of the larger components of the industry--fish processing and frozen foods--employ a higher percentage of female than

TABLE LX

FOOD AND KINDRED PRODUCTS BY SUBORDINATE INDUSTRY GROUPS

Type of Industry	Value of Product	Gross Wages Paid	Total Employment
Food and Kindred Products	$185,941,383	$27,431,178	10,054
Meat Packing	1,321,274	178,616	57
Prepared Meat	8,968,368	1,015,869	278
Poultry Processing	42,813,241	3,097,828	1,169
Dairy Products	13,131,802	1,086,318	351
Canned Sea Food	20,109,833	4,189,715	2,162
Cured Fish	880,789	212,952	182
Canned Fruits, Vegetables	20,088,318	3,054,942	1,161
Pickled Fruits, Vegetables	624,346	141,576	47
Frozen Foods	24,608,091	4,682,942	1,813
Grain Products	14,845,554	768,710	208
Bakery Products	25,004,337	6,342,642	1,779
Confectionery Products	287,255	73,508	41
Beverage Industries	5,738,266	1,284,505	434
Corn Products	3,660,627	514,282	144
Flavoring Extracts	498,900	144,603	45
Other Food Preparations	3,360,382	642,170	183

male employees. The generally lower wage scale paid to female employees has resulted in a below-average wage level in the food-processing industry. The average gross wage paid for all manufacturing industries in Maine was $3415 in 1956 and $3551 in 1957, while the average gross wage in Maine's food-processing industry was $2736 in 1956 and $2995 in 1957. Part of this difference in gross wage levels can, however, be attributed to the highly seasonal character of some segments of the food-processing industry in Maine which results in fewer working days per year.

The food-products industry is of importance in all 16 Maine counties. It is the leading manufacturing industry in terms of value of product in six counties and the leading employer in five. (See Table LXI.)

The food-products industry is of particular importance in Washington County. In 1956, only Cumberland County had more workers in this industry than Washington County. Food processing, primarily sardines and blueberries, accounted for 37.5% of Washington County's manufacturing in 1957. In the past decade, however, it has declined in Washington County, contrary to the experience of the state in general. Figure 18 shows the decline during 1949-1957.

The decline is attributable to decreased sardine packing in the county. Total U. S. per-capita fish consumption has declined approximately 8% over the last 20 years. The consumption of canned fish has decreased at an even greater rate--from 4.80 pounds per capita in 1935-1939 to 3.42 pounds per capita in 1956. Sardine consumption, in particular, has suffered. Traditional markets in the South, where sardines have long served as low-cost food among low-income groups, have declined in almost direct proportion to increases in per-capita income. Washington County sardines reaching the higher-price market have also decreased as a result of effective competition from Scandinavian and other imports. In recent years, the over-all decline in the county's food-processing industry has been tempered by increases in blueberry production. The construction of the proposed cold-storage warehouse in Washington County would stimulate further increase in blueberry processing and, in part, offset expected decreases in sardine packing.

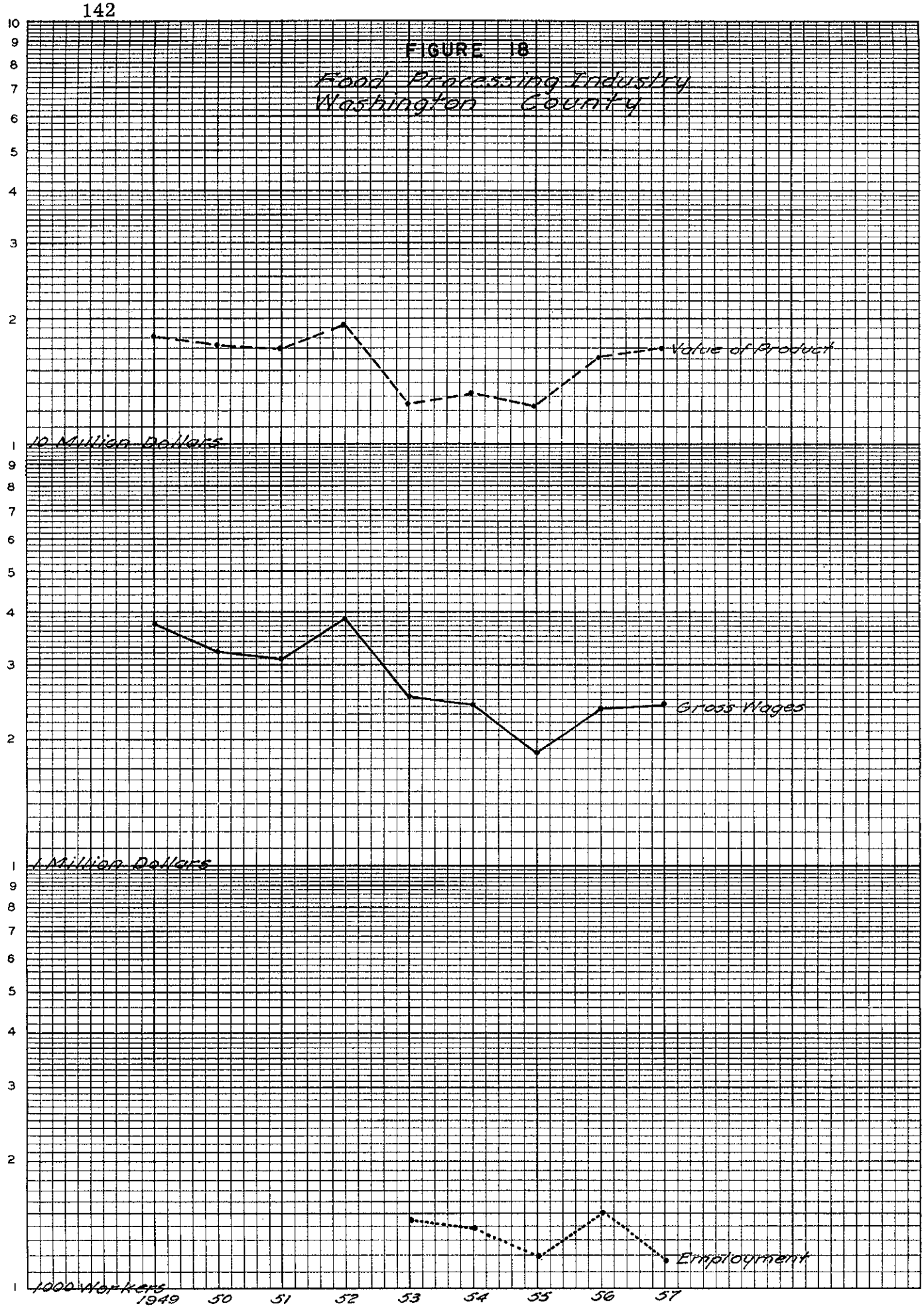
TABLE LXI

FOOD AND KINDRED PRODUCTS

County	Value of Product	Gross Wages Paid	Average Gross Wages	Number of Workers
TOTAL	$185,941,383	$27,431,178	$2,728	10,054
Androscoggin	8,638,652	1,295,364	3,062	423
Aroostook	17,348,149	2,838,071	2,962	958
Cumberland	65,091,936	10,185,113	3,133	3,251
Franklin	643,231	100,208	1,728	58
Hancock	4,860,057	708,507	1,621	437
Kennebec	23,965,173	2,503,969	2,803	894
Knox	8,038,585	1,841,253	2,744	671
Lincoln	781,183	126,911	1,923	66
Oxford	3,033,701	540,382	2,561	211
Penobscot	14,836,746	2,337,820	3,088	757
Sagadahoc	866,262	189,781	1,757	108
Somerset	1,001,935	352,158	2,229	158
Waldo	20,029,392	1,773,076	2,758	643
Washington	16,026,586	2,394,763	1,784	1,342
York	779,795	241,802	3,140	77

FIGURE 18

Food Processing Industry
Washington County



F. OTHER MANUFACTURING

Our report has discussed separately the major manufacturing industry groups in Maine. The major components--textiles, leather and leather products, forestry products, and food processing--accounted for 82% of the state's total product value in 1957 and 81% in 1956, and 74% of total manufacturing employment in 1957 and 76% in 1956. There are no other manufacturing industries of comparable size within the state. Several smaller industries, however, have a substantial economic impact on particular geographical areas of the state; when combined, they constitute a significant part of Maine's industrial structure. We shall restrict our discussion to those industries employing at least 1000 workers. One exception deserves mention: the electrical and electronics industry, which employed slightly over 900 workers within the state in 1957. Maine has only two such companies of any significant size--Sylvania and General Electric. They account for almost the entire output and employment of this industry in Maine. General Electric, however, has announced plans to close its Maine plant principally because distance to markets makes it noncompetitive. With the closing of this plant, the electronics industry will be of minor importance in the state. General Electric's reason for closing its plant is expected to restrict the industry's growth in Maine.

1. Shipbuilding

Transportation equipment, principally shipbuilding, is of major importance to several Maine communities. It is the next largest in size after those industries discussed in separate sections of this report. It is concentrated at two locations: Kittery and Bath. The Portsmouth Naval Shipyard, while taking its name from the New Hampshire city, is actually located just over the Maine line at Kittery. Operated by the U. S. Navy, the shipyard employs over 6000 workers, a substantial number of whom live in neighboring New Hampshire communities. The future effect of this installation on Maine's economy is based on two countermanding factors: the limited size of the ways, which restricts its operation to smaller naval vessels; and the Federal Government's stated policy to place contracts in economically depressed areas whenever possible. It seems clear that the naval shipyard will continue as an important employer in southern Maine.

The second largest shipbuilding employer is the Bath Iron Works, at Bath. Here, as at Kittery, the limiting factor is the size of vessel that can be handled. The Bath Iron Works builds steel vessels up to 500 feet in length. Employment was high during both World Wars, but it has declined somewhat during recent years. The future of this operation as a major employer is questionable. The company has diversified in recent years; however, substantially all of the acquired facilities are located outside Maine.

Small shipbuilding remains of some importance in Cumberland and Lincoln Counties. At one time this was one of the most important industries in Maine, but its position has steadily declined.

2. Machinery and Ordnance

The machinery and ordnance industry is of diminishing importance to the state. Saco-Lowell shops at Biddeford, Fayscott Corporation at Dexter, Southworth Machine Company at Portland, and Alloy Products Company in Sanford each employ over 100 workers. Saco-Lowell, the largest of these companies, is principally a textile-machinery manufacturer. It is presently moving its textile machinery operation to the South, where it will be closer to the majority of its customers in the textile industry. Other machinery manufacturers serving this market are expected to follow. Thus, the long-term outlook for the machinery-manufacturing industry in Maine is not favorable as nearness to markets becomes increasingly important. The industries that Maine machinery manufacturers serve are in general either declining (boatbuilding) or moving South (textiles), while machinery used in industries expected to experience growth in Maine (food products, paper, and shoes) are almost entirely manufactured outside the state.

3. Apparel

Maine's apparel industry has experienced recent growth. In 1957, of the 2604 workers employed, 85% were female. This growth parallels increases in other New England centers such as Boston, New Bedford, and Fall River, where low wage scales have attracted garment shops away from the New York garment center. This recent growth in Maine's apparel industry is more nearly a small-scale recapture of an industry that was of substantial importance prior to the year immediately following World War II. For example, in 1957, apparel employment was only 73% of what it was in 1947. It now appears that gains have been

maximized, and no further growth is expected. The ease of entry and lower wages in Maine will allow manufacturers to take advantage of geographical wage differentials (Washington County, for example) and thereby insure retention of present employment levels within the industry.

4. Metal Fabrication

The metal-fabricating industry in Maine employed an average of 2224 workers in 1957, a decline of exactly 10% from the previous year. The industry is concentrated in the Portland area, with Cumberland County accounting for 74% of the total employment in 1956. Metal fabricating has experienced an above-average growth in Maine during the past decade. While the industry in the United States has grown 14% in terms of employment and 81% in terms of value added, in Maine it has increased 18% in employment and 87% in value added. By contrast, New England's employment in this industry decreased 13% between 1947-1956, while value added by manufacture increased only 43%. Statistics alone, however, are somewhat misleading. Although 1947-1956 shows a substantial total growth, 1947-1955 shows a decline.

Several factors preclude substantial expansion of this industry in Maine. Foremost amongst these is that the industry is highly market-oriented, and the market in Maine is limited. That no growing market exists in New England is evidenced by the industry's decline there during the past decade. The industry has tended to concentrate in Detroit, Cleveland, and Los Angeles, where it is near the major markets. Furthermore, the industry needs iron and steel at reasonable price. It seems clear, in view of the financial failure of the Bridgeport steel mill, that New England demand cannot support an integrated steel mill in the area. As a result, Maine, in particular, will remain at a competitive price disadvantage for iron and steel, and this will offset any advantage gained by a lower wage level.

There are no significant manufacturing industries in Maine other than those previously discussed. The printing industry, primarily newspapers, employs approximately 2000 persons, but it has experienced little growth. The decline in the furniture industry has resulted in employment of less than 800 and the industry is expected to follow New England in further decline. The chemical industry employed only 749 workers in 1957, and lack of raw materials, and distance to markets limit further growth. Stone and clay industries employed an average of 838 employees in 1957, with over one-third of those employed at a single establishment, a cement plant at Thomaston. This is a domestic industry serving a regional market.

5. Washington County's Participation

Washington County participates in three of these smaller industries. The prevailing low wage scale has attracted several garment shops. One, at Eastport, employs approximately 75 women in the manufacture of ladies' lingerie, and a knitting mill at Calais employs over 100 operators. The survival of these establishments depends on a continuance of the wage differential. The American Can Company employs approximately 100 workers at its factory in Lubec. This operation supplies containers for the area's sardine and animal-food plants. In addition, four chemical plants employing a total of approximately 50 workers use fish waste to manufacture fertilizer and lacquer. The limited size of the local market and the disadvantage of remoteness to other markets will continue to restrict the growth of these industries.

VIII. TRANSPORTATION

A. RAIL

Adequate rail service is provided to both the state as a whole and to Washington County. Forest products, paper and paper products, potatoes, and petroleum products account for a high proportion of all rail traffic within the state. No large increase in traffic volumes is expected; however, the increase expected in the forest-products industries will be reflected in higher tonnage for the railroads. Rail passenger service within the state has been widely curtailed during the past few years, and further suspension of service can be expected.

Rail transportation in Maine is provided by five Class-I railroads and four Class-II lines operating 1805 miles of main-line track. (See Figure 19.) The Boston and Maine Railroad operates the highest-density traffic route, connecting Portland with Boston and the south, and operates 43 miles of track in Maine. The Maine Central, with 944 miles of track in Maine, operates throughout the central area of the state. It connects with the Boston and Maine at Portland, in the south, with the Bangor and Aroostook near Bangor, in the north, and with the Canadian Pacific and St. Johnsbury and Lamoille County railroads at St. Johnsbury, Vermont, in the west. The Bangor and Aroostook, operating 596 miles of track in northern Maine, connects in the south with the Maine Central near Bangor and in the west with the Canadian Pacific at Greenville. The Canadian Pacific operates 177 miles in Maine on its main line, linking the Atlantic Provinces with Montreal. It connects with the Bangor and Aroostook at Greenville, in the west, and with the Maine Central at Vanceboro, in the east. The Canadian Pacific also serves northern Aroostook County with a line from Presque Isle to Aroostook. The fifth Class-I railroad serving Maine is the Grand Trunk Railway of the Canadian National System. It operates 90 miles of track in Maine with a line serving Portland and connecting with the Canadian National main line at Sherbrooke, Quebec. The Portland Terminal Company, a subsidiary of the Maine Central, operates 15 miles of track at the port of Portland. The Belfast and Moosehead Lake Railroad operates 33 miles of track connecting Belfast with the main line of the Maine Central at Burnham Junction. The Sanford and Eastern Railroad operates 31 miles of track connecting Sanford with the main line of the Maine Central at Westbrook. The Aroostook Valley Railroad, operating 32 miles of track in northern Aroostook County, connects with the Canadian Pacific Railway at Washburn Junction.

A relatively few commodities make up the bulk of tonnage moved by Maine railroads. (See Table LXII.) Potatoes, pulpwood, and paper and paper products comprise the principal tonnage originating within the state.

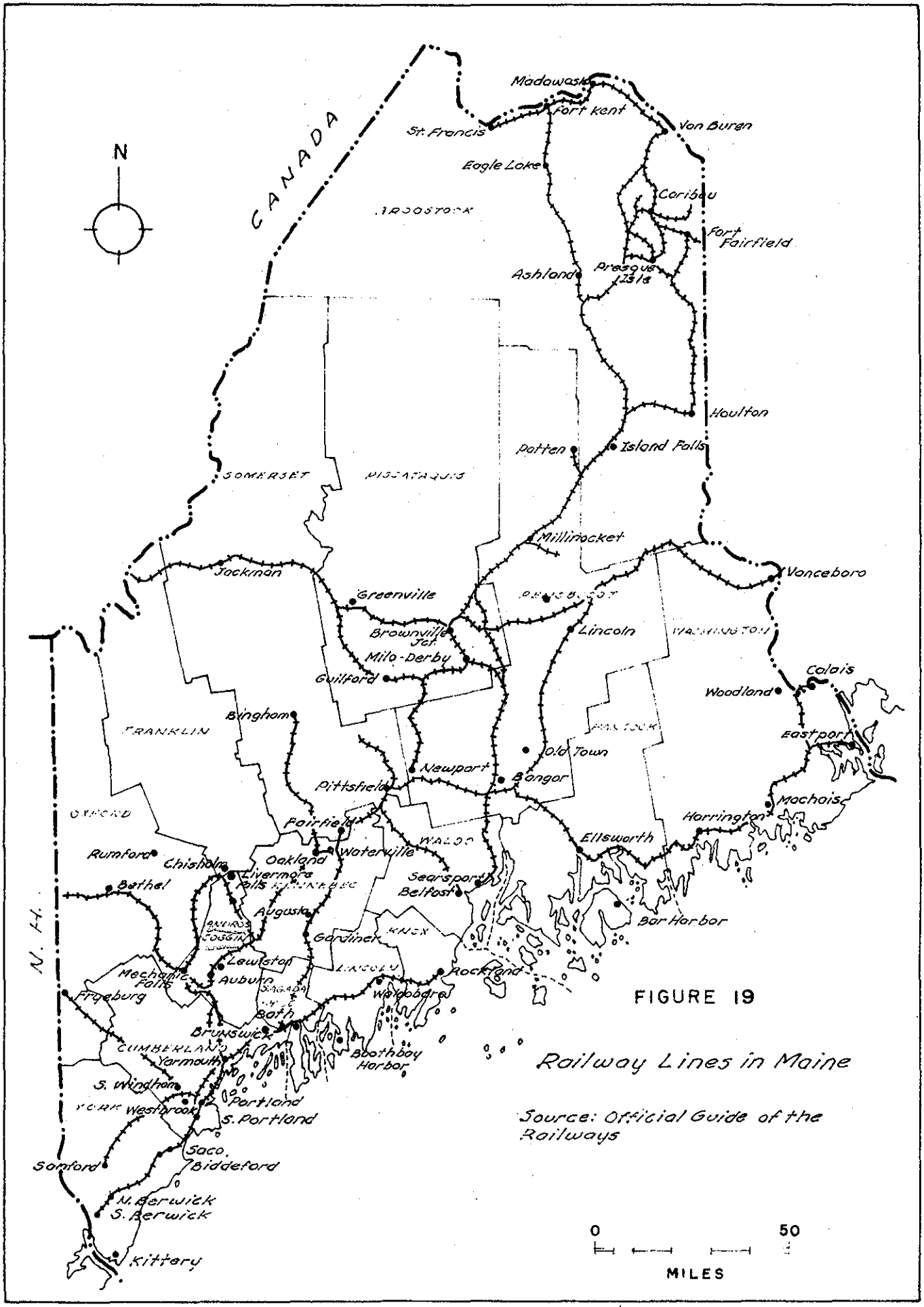


FIGURE 19

Railway Lines in Maine

Source: Official Guide of the Railways

TABLE LXII

REVENUE FREIGHT ORIGINATED AND TERMINATED BY MAINE'S CLASS-I RAILROADS, 1954

(tons)

Commodity Class	Originated	Terminated
Product of Agriculture		
001 Wheat		78,300
003 Corn		16,800
007 Oats	35,900	16,000
011 Rice		3,000
015 Flour Wheat		68,100
019 Flour Edible, NOS		5,300
021 Cereal Food Prepared, NOS		4,000
023 Mill Products, NOS		16,700
033 Cotton in Bales		43,400
035 Cotton Linters, Noils, and Regins	7,600	1,500
045 Soybean Oil Cake and Meal		3,000
051 Bananas Fresh		6,300
055 Cantaloupes and Melons, NOS		1,100
061 Oranges and Grapefruit		7,900
067 Watermelons		5,000
073 Fruits Frozen		4,400
085 Potatoes, not sweet	846,900	37,500
091 Beans and Peas, dried		16,100
199 Products of Agriculture, NOS	1,200	
900 Total Products of Agriculture	897,300	342,200
Animals and Products		
215 Meats, fresh, NOS		30,100
217 Meats, cured, dried and smoked		4,500
219 Packinghouse Products Edible, NOS		4,700
229 Butter		3,300
231 Cheese		2,100
237 Wool and Mohair, NOS		700
239 Hides, Skins and Pelts, NOS		8,100
299 Animals and Products, NOS	6,400	
910 Total Animals and Products	16,000	54,700

TABLE LXII (Continued)

Commodity Class		Originated	Terminated
Products of Forests			
401	Logs, Butts and Bolts	42,500	23,700
403	Posts, Poles, Wooden		10,900
409	Pulpwood	1,363,900	1,274,200
411	Lumber, Shingles and Lath	185,300	84,200
413	Box Materials	31,200	2,400
415	Veneer and Plywood	10,300	10,500
499	Products of Forest, NOS	72,900	25,600
930	Total Products of Forests	1,710,700	1,431,500
Manufactures and Miscellaneous			
501	Gasoline	211,000	191,600
503	Fuel, Road and Residual Oils, NOS	333,700	292,500
505	Lubricating Oils and Greases		17,200
507	Refined Petroleum, NOS	72,600	93,700
509	Gases, not petroleum, NOS		2,600
513	Linseed Oil		3,100
515	Soybean Oil	5,200	3,100
523	Rubber, crude		4,300
527	Chemicals, NOS		48,800
531	Acids, NOS		2,900
533	Sodium Products		18,700
539	Fertilizers, NOS	66,600	64,600
541	Insecticides and Fungicides, NOS		2,900
543	Tar, Pitch and Creosote	4,800	24,200
547	Paint, Putty and Varnish		5,800
581	Iron and Steel Nails and Wire, NOS		8,800
583	Manufactured Iron and Steel	15,900	168,700
585	Cast Iron Pipe and Fittings		4,500
587	Iron and Steel Pipe and Fittings, NOS	8,700	1,200
591	Agricultural Implements, NOS		1,400
595	Machinery and Machines, NOS	15,800	18,200
597	Machinery Parts	6,500	3,000
603	RR Equipment on own wheels		12,000
611	Vehicles, not motor		1,000
613	Automobiles, passenger		8,400
615	Automobiles, freight		3,100
617	Vehicles, motor, NOS		4,900

TABLE LXII (Continued)

Commodity Class		Originated	Terminated
Manufactures and Miscellaneous (Continued)			
627	Tires and Tubes, rubber		500
633	Cement, Portland		7,800
639	Brick and Building Tile		7,000
641	Refractories		6,800
645	Lime, NOS	6,000	40,500
647	Plaster, stucco and wall		5,100
649	Sewer Pipe, not metal		10,000
653	Woodpulp	321,700	176,500
655	Scrap Paper and Rugs	13,700	12,600
657	Newsprint Paper	410,900	25,900
659	Printing Paper, NOS	564,500	6,500
661	Wrapping Paper	52,100	3,700
663	Paper Bags		8,600
665	Paperboard, Fibreboard and Pulpboard	87,800	9,100
671	Wallboard		22,400
673	Building Paper and Roofing Materials		12,100
675	Insulating Materials, NOS		3,800
679	Building Materials, NOS		1,800
685	Electrical Equipment and Parts, NOS		1,500
687	Furnaces, Heaters, Radiators		4,200
689	Bathroom Fixtures		2,500
697	Glass Bottles and Jars		16,900
703	Woodenware	29,800	13,200
707	Refrigerators		900
709	Laundry Equipment		1,900
711	Stoves, Ranges and Parts		1,700
713	Floor Covering		2,000
715	Furniture, NOS	1,900	1,300
721	Abrasives, not crude		1,500
727	Cotton Cloth and Fabric, NOS	4,500	
729	Cotton Factory Products	500	
733	Cloth and Fabrics, NOS	1,200	
735	Rope, Cordage and Twine		2,800
743	Games and Toys		4,200
745	Liquors, alcoholic, NOS		3,000
747	Wine		2,600
749	Liquors, Malt		51,700

TABLE LXII (Continued)

Commodity Class	Originated	Terminated
Manufactures and Miscellaneous (Continued)		
751 Beverages, NOS		2,000
759 Sugar		16,900
763 Food Products in Cans and Packages, NOS	115,300	93,500
765 Food Products, frozen, NOS	23,400	10,600
767 Starch	43,200	25,300
773 Feed, animals and poultry, NOS	35,700	391,000
775 Manufactured Tobacco, NOS		2,700
777 Cigarettes		2,700
779 Containers, metal		1,600
783 Containers, fibreboard and paperboard	3,300	18,200
785 Containers, NOS	7,300	11,200
787 Containers, returned empty	13,600	2,900
789 Scrap Iron and Steel	81,100	31,900
795 Scrap for Smelting	2,200	
797 Waste Materials, NOS	5,000	1,200
799 Manufactures and Miscellaneous	600	6,500
940 Total Manufactures and Miscellaneous	3,074,100	2,289,500
950 Forwarder Traffic		3,000
960 Total All Commodities	6,525,300	5,358,600

Source: Bureau of Transport Economics and Statistics of the Interstate Commerce Commission.

The termination figures indicate that the majority of pulpwood tonnage terminated within the state. Other commodities comprising a substantial part of the tonnage terminated in Maine include petroleum products and animal and poultry feed. In terms of tonnage originated and terminated in Maine, the two most important carriers are the Bangor and Aroostook and the Maine Central. The principal commodities carried by these two lines during the past three years are shown in Table LXIII.

An analysis of these traffic volumes indicates that because of the importance of pulpwood tonnage, a substantial part of the traffic is short-haul. In 1957, the average distance that revenue freight was hauled was 130.5 miles for the Bangor and Aroostook and 121.4 for the Maine Central. As a result, revenue per ton carried was substantially below the national average. For the B&A, average revenue per ton carried was $3.44 in 1956 and $3.78 in 1957. For the Maine Central, the average revenue per ton carried was $3.29 in 1957 and $3.09 in 1956. The average for all Class-I U.S. railroads in 1956 was $6.48.

Although the volume of traffic and the operating revenues for the Bangor and Aroostook are consistently smaller than those for the Maine Central (57% in 1957), the Bangor and Aroostook has been more profitable in both absolute and relative terms. In addition to transportation operating revenues, the B&A has substantial property holdings at Searsport, an interest in the St. Croix Paper Company, a profitable bus line, and other interests. The importance of its potato shipments provides stability during periods of depressed economic conditions, while pulp and paper shipments particularly benefit the line during periods of economic prosperity. Past records indicate that during the past 30 years, the B&A consistently performed better from a financial point of view than have a majority of Class-I lines.

All of the Class-I railroads in Maine provide some passenger service, but it is becoming increasingly limited because it involves a net loss to the railroads. For example, the Bangor and Aroostook reportedly lost in the neighborhood of $800,000 on its passenger service in 1957, although rail passenger service was substantially reduced during the year. The Maine Public Service Commission has been unusually responsive to the railroads' petitions to reduce passenger service. During 1957, the Commission granted permission to the B&A to eliminate two of its four passenger trains and to the Maine Central to discontinue service from Bangor to Calais and from Portland to Farmington. In view of this recent trend, it can be expected that bus transportation will be substituted for rail passenger service north and east of Portland in the near future. It is significant that bus service already substituted has

TABLE LXIII

MAJOR COMMODITIES AS PERCENTAGE OF TOTAL TONNAGE CARRIED

	1955		1956		1957	
	MCR	B&A	MCR	B&A	MCR	B&A
Potatoes	9.4	17.8	10.1	18.0	10.3	18.2
Paper and Paper Products	15.0	18.3	16.1	17.3	16.7	18.1
Pulp	21.2	28.6	20.7	31.8	19.2	26.6
Feed and Grain	7.0	-	7.6	-	8.6	-
Petroleum Products	7.2	10.6	6.8	9.4	6.7	11.7
Coal	7.2	7.1	7.7	7.4	7.9	7.6
Cement	5.3	1.5	3.8	0.9	3.6	-
Lumber, Shingles and Lath	2.1	1.6	1.9	1.7	1.7	1.5
Fertilizer	-	3.2	-	3.2	-	3.1

been remunerative as well as faster. The Bangor and Aroostook has evidenced leadership by providing its own modern bus service to all the points previously served by rail. It also provides interstate bus charter service. The B&A's bus service revenues increased 15% during 1957.

The volume of rail freight tonnage is reported to be greater than the combined tonnage of all other commercial traffic. Although both interstate and intrastate common carrier truck traffic has grown extensively in Maine, the railroads have maintained their predominance, in absolute terms, principally because: (1) the transportation of pulp and paper products lends itself better to rail shipments, and (2) competitive rates have been provided so that the potato traffic can be retained.

The Maine Central Railroad provides rail service to Washington County. In addition, the Canadian Pacific cuts across the northern tip of the county. Maine Central's line to Washington County extends from Bangor to Calais, with branch lines to Eastport and Woodland. Moreover, the line from Bangor to Vanceboro offers service to the northern part of the county. The principal commodities carried in Washington County are paper from the St. Croix Paper Co. plant at Woodland and fish products from Eastport. Considerably greater traffic could be carried on this line with the present facilities of the Maine Central.

The expected growth of Maine's forest-products industries will be reflected in higher tonnage transported by Maine railroads. The aggressive sales program, particularly Bangor and Aroostook's, can be expected to offset inroads made by the trucking industry. Inasmuch as rail shipments are closely tied to the production of the region served, no large-scale growth in tonnage is expected. Present rail facilities are adequate to serve the region during the period under study. The railroads can be expected to build new lines if substantial volumes of traffic are generated at points not now served by rail.

B. WATER[1]

The raw-material requirements of Maine's industry have not led to substantial waterborne commerce at the state's ports. With the exception of industrial fuels, few commodities have generated water

1. In our discussion of waterborne commerce in Maine we have made liberal use of the excellent study by Professor H. Austin Peck: An Economic Study of Seaports in Maine. Orono: University of Maine, Department of Industrial Cooperation, 1955.

traffic. Over 75% of all waterborne commerce is handled at Portland. Over 90% of the tonnage, substantially all petroleum or coal, is inbound traffic. Because of the lack of export cargoes, ship owners have been reluctant to make regularly scheduled calls at Maine ports. Only slight increases in the volume of traffic moving through the ports is anticipated.

Waterborne commerce in Maine has an important historical position. At the turn of the century Bangor was the largest lumber port in the world, and shipping between Maine ports and other east coast ports was of major significance. In fact, at one time Maine ports were among the most active in the country. Population shifts and improvements in other forms of transportation, however, reduced the state's maritime commerce to insignificance. Its water transportation has increased slightly in recent years, primarily because of increased shipments of petroleum products into the state.

The Port of Portland is in all respects the most important commercial port in Maine. Substantially all of the waterborne commerce in the state moves into or out of Portland. Not only is Portland Maine's largest city and the center of the state's population concentration, but its port offers the best maritime facilities. Ice-free and landlocked, it is only 3.5 miles from the open ocean. The channel between the docks and the ocean has a 35-foot depth at mean low water. The two principal piers--the State Pier and the Canadian National Railway Pier--front 35 feet of water.

During the postwar period there has been an almost uniform annual increase in the tonnage moving through Portland. (See Table LXIV.) This increased volume follows almost entirely from the movement of petroleum products. (See Table LXV.)

Most of the petroleum coming into Portland is crude oil from foreign countries and destined for Montreal refineries. Portland is the eastern terminus of a petroleum pipeline extending from South Portland to Montreal East. The crude is received from tankers at the South Portland tank farm. Small amounts of refined petroleum, received primarily from coastwise shipments, are used as fuel within the state.

The second largest volume of traffic is represented by coastwise receipts of coal, which accounted for 3.03% of total traffic in 1957 and 4.06% in 1956. The balance of traffic handled at Portland was almost insignificant. This absence of general cargo traffic is the port's principal problem. A second major problem is the great disparity between receipts and shipments. In 1956, receipts were 24.71 times as great as shipments. As a result of the small amount of outbound traffic, ship owners hesitate to schedule regular calls at Portland.

TABLE LXIV

TOTAL FREIGHT TRAFFIC THROUGH PORT OF PORTLAND, 1947-57
(tons)

1947	6,677,060
1948	7,583,938
1949	6,847,619
1950	7,824,564
1951	10,317,208
1952	11,302,202
1953	11,720,502
1954	11,782,242
1955	14,218,466
1956	15,890, 156
1957	16,396, 987

TABLE LXV

PETROLEUM SHIPMENTS INTO PORT OF PORTLAND, 1947-57
(tons)

Year	Total	Percent of Total
1947	5,502,371	82.41
1948	6,464,502	85.24
1949	4,967,376	72.54
1950	6,951,970	88.85
1951	9,302,939	90.17
1952	10,351,642	91.59
1953	10,739,372	91.63
1954	10,840,991	92.01
1955	13,229,076	93.04
1956	14,870,714	93.58
1957	15,550,000	94.83

Portland, as Maine's principal rail center, would seem ideally located to handle import or export traffic destined for or originating on rail lines to the west of Maine. Two factors, however, have militated against the building up of this traffic: (1) although the port is a shorter distance from European and other principal ports, the ocean shipping rates from all Atlantic and Gulf ports have been equal for many years; and (2) rail rates in and out of Portland for export and import traffic are generally higher than those in Baltimore, Philadelphia, and Norfolk. There is one exception: rates between Portland and the Central Freight Association Territory are equal or below those at other Atlantic Coast ports. However, only a relatively small volume of traffic for the Central Freight Association Territory has been handled through the Port of Portland, and little increase is expected.

In terms of volume, the second most important Maine port is Searsport, at the southern terminus of the Bangor and Aroostook Railroad. It offers an excellent year-round harbor with adequate port facilities, part of which are owned and were developed by the Bangor and Aroostook. (See Table LXVI.)

TABLE LXVI

TOTAL FREIGHT TRAFFIC THROUGH PORT OF SEARSPORT - 1947-57

(tons)

1947	757,522
1948	758,202
1949	403,019
1950	775,627
1951	589,757
1952	731,628
1953	668,579
1954	722,291
1955	945,540
1956	1,073,778
1957	1,087,703

As in the case of the Port of Portland, the most important commodity, and increasingly so, is petroleum products. In 1957, they represented 61.16% of total tonnage, compared with 42.72% in 1956. Bituminous coal is the second-highest-volume commodity moving through Searsport, but its importance has declined recently. Searsport is the starting point

for a Government-owned petroleum pipeline leading to Limestone Air Force Base, in Limestone, Maine. Chemicals and other fertilizer materials for the Northern Chemical Company's plant at Searsport make up another important category of tonnage received at Searsport. The disparity between receipts and shipments at Searsport is identical with that at Portland. Only during certain years when exports of potatoes have been substantial have shipments out of Searsport exceeded 10% of total tonnage handled. Lack of shipments has therefore hindered development of the port. The railroad, however, is aggressively promoting the use of the port, and has succeeded in routing some shipments of newsprint and paper out of Searsport.

Third in importance are the various ports on the Penobscot River. Commodities are received at a number of docking facilities from the mouth of the river to Bangor; however, the river cannot accommodate ships of the same draft as those handled at Portland and Searsport. Coastwise shipments of petroleum products represent the preponderance of tonnage handled. The disparity between incoming and outgoing shipments on the Penobscot is even greater than that at Portland and Searsport; in certain years, however, there have been substantial outbound shipments of paper and paper products.

There are no other Maine ports through which any substantial volumes of commercial traffic move. In Washington County, a small volume of water commerce is reported for Eastport and Lubec Channel. (See Table LXVII.)

TABLE LXVII

TONS OF TRAFFIC THROUGH EASTPORT AND LUBEC

Year	Eastport	Lubec
1947		49,247
1948		40,648
1949		44,214
1950		67,185
1951		79,984
1952		116,439
1953	76,701	78,186
1954	63,290	88,385
1955	49,451	74,772
1956	60,225	87,913

Approximately 50% of the tonnage recorded at Lubec was river or harbor through-traffic, neither loaded nor discharged at Lubec. Substantially all of it was carried in vessels with a draft of less than seven feet. Roughly 50% of the tonnage at both Lubec and Eastport was fish or fish products.

No significant increase in the amount of waterborne commerce in Maine can be foreseen. Apart from industrial fuels, no commodities are received in substantial quantities at Maine ports, and the raw materials used by Maine industries are either available in the state or more advantageously shipped by means other than water. Maine production cannot be expected to generate substantial outbound water shipments, although a slight increase in shipments of paper and paper products can be expected. Although the Maine Port Authority and others are making concerted efforts to obtain for Portland export and import shipments originating or terminating in states other than Maine, only nominal tonnage of this traffic can be expected to go through Maine ports. The opening of the St. Lawrence Seaway can be expected to have little effect on the cargoes presently handled at Maine ports. However, it can be expected to have a competitive influence on their ability to obtain new cargoes moving to and from the Midwest.

C. AIR

Scheduled airline service to Maine is not profitable because of the small volume of traffic generated. The quality of the service can be expected to improve through the use of better equipment, but service to certain cities will be suspended as population declines. There is no commercial airline service to Washington County, and none can be expected in the future.

The existing scheduled air transportation system in Maine is provided exclusively by Northeast Airlines. (See Figure 20.) Service is provided to nine airports, from Presque Isle in the north to Portland in the south, with connections to Boston. Nonstop flights are infrequently scheduled from Portland to New York and from Bangor to Boston.

The state's population is so distributed that the airline must fly the full north-south length of the state to serve the population centers, but the population is not concentrated enough to avoid frequent landings. As little as 20 miles separate the cities at which landings are made. As a result of the number of cities served and the small volume of traffic generated, airline operation has not proven profitable. Until Northeast Airlines was granted the high-traffic-density route from Boston and New York

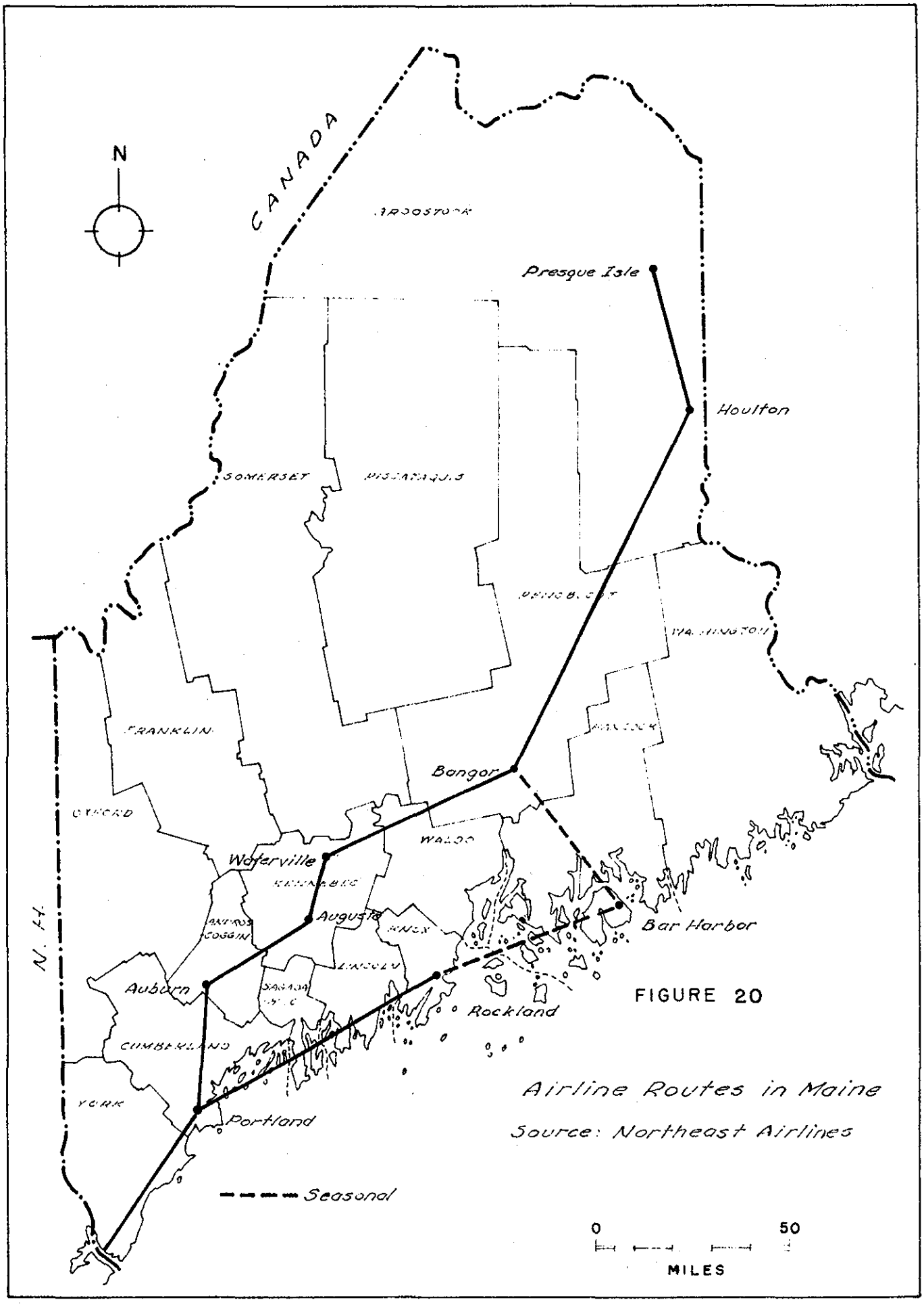


FIGURE 20

Airline Routes in Maine

Source: Northeast Airlines

to Miami, a federal subsidy was required for breakeven operations. Under the present route structure, anticipated profits from the Florida segment of the route will be required to underwrite the airline's losses from its Maine service.

A further obstacle to profitable air-traffic volume in Maine is the high-speed highway that parallels the air route from Boston to Augusta. The effective time from door to door between Maine points along this route and destinations within Boston or other parts of New England is now about as short by automobile as by airline. The added advantages of lower cost and convenience will continue to make automobile traffic increasingly competitive with scheduled air travel to Maine. Northeast Airlines has planned improved service with faster, more economical aircraft to insure that air traffic maintains or increases its share of the traffic market. Curtailment of passenger trains to and from Maine has already increased the air-traffic volume.

Total scheduled airline passengers in and out of Maine increased 107%, from 99,477 in 1950 to 206,116 in 1957. By way of comparison, the total unduplicated number of revenue passengers carried by U. S. domestic scheduled air carriers increased 141% during 1950-1956. The Portland area accounts for the greatest volume of air traffic in and out of Maine. (See Table LXVIII.) This traffic increased only 93% during 1950-1957, while that to and from other points in Maine increased on the average 122%. The largest growth in volume was to Presque Isle; it exceeded 600% during this period. There is no significant difference between inbound and outbound traffic to Maine points.

The passenger-traffic volume represented 0.24% of the U. S. total. In comparison, Maine's 1956 population, according to Bureau of the Census figures, represented 0.56% of the U. S. total.

During the past decade, the number of Maine cities served has not been increased. For a short period, scheduled service was provided to Millinocket, but the traffic was too small to justify continuation of the service, and it was suspended in 1956. Northeast Airlines has applied to the Civil Aeronautics Board for permission to continue to suspend this service. The present volume of traffic generated by several of the smaller scheduled stops raises the question as to how long the airline can reasonably be expected to continue this unprofitable service. Although the airline has not petitioned the Civil Aeronautics Board for suspension of service within Maine, it can be expected that the continued low volume of traffic generated in certain cities will necessitate such action.

TABLE LXVIII

AIR-TRAFFIC VOLUME IN MAINE, 1956

Community	Aircraft Departures	Enplaned Passengers	Tons Air Mail	Tons Cargo	Passengers as Percentage of U. S. Total
Augusta	1,860	4,863	3.9	17.0	.01
Bangor	2,346	22,394	15.1	117.7	.05
Bar Harbor*	447	3,184	1.3	62.0	.01
Houlton	626	1,259	3.6	1.4	--
Lewiston	2,144	5,929	13.0	34.8	.01
Portland	4,662	39,848	52.2	311.1	.10
Presque Isle	758	12,320	16.4	8.8	.03
Rockland	1,223	4,957	1.7	11.3	.01
Waterville	1,031	3,570	5.8	5.2	.01
Total	15,097	97,324	113.0	569.3	.24

*Seasonal.

There is no scheduled airline service to Washington County, nor is any contemplated. Adjoining Hancock County receives only seasonal service at Bar Harbor. The airport serving Bar Harbor is the only one within Hancock and Washington Counties where facilities are adequate to serve commercial airlines, although a field capable of supporting marginal service is located at Princeton, in Washington County. The "National Airport Plan for 1958," prepared by the Civil Aeronautics Administration, lists the following five sites in Washington County as needing airport development during the period 1958-1965:

City	Existing Facility	Required Facility
Deblois	Trunk	General Service
Eastport	Secondary	General Service
Lubec	Secondary	General Service
Machias	None	General Service
Princeton	Trunk	General Service

Inclusion in the National Airport Plan is a prerequisite for participation in the Federal Aid Airport Program. Facilities adequate for commercial air traffic at Washington County airports are not deemed necessary under the National Airport Plan.

D. HIGHWAYS

Maine's highway transportation has developed rapidly during the past decade. Improved roads have reduced transit times and secured larger shares of tonnage for truckers. This growth will continue as new highway improvements are made. The highway system, existing and planned, is adequate to serve the needs of the state.

Common-carrier motor transportation in Maine has also grown rapidly during the past decade, primarily because of improved state highways connecting Maine with Boston and other market areas. Because the modern highway system has promoted the rapid movement of commodities, it provides severe competition to the railroads. With the proposed extension of the thruway north of Augusta, motor truck

competition will increase, as delivery time between Maine points and market areas is decreased.

At present 56 certificated intrastate common carriers operate within Maine, and 521 trucking companies hold certificates of public convenience and necessity to operate as interstate carriers. Bus service is provided by 36 intrastate carriers and six interstate carriers, which serve substantially all population centers in the state and provide transportation to and from the other New England states and the Maritime Provinces.

Its network of public highways represents a considerable annual expense. The state's total highway mileage is 20,700, of which only 3270 miles are improved. A high percentage of total highway maintenance expenses (over 50% in many years) goes for snow removal during the winter months. The major highway in the system is the 111-mile Maine Turnpike. The first half of this superhighway, covering the 45 miles from the New Hampshire border to Portland, was opened in December, 1947. The remaining section, extending to Augusta, opened in December, 1955. The highway has shown a steady, though not remarkable, growth in traffic. The Maine Turnpike Authority reports the number of vehicles entering the turnpike as follows:

1955	2,701,519
1956	3,808,382
1957	4,023,818

Reports indicate that recent increases in toll rates have resulted in a diversion of considerable traffic to parallel free roads. Planned construction under the Federal Aid Highway Act calls for extension of this highway as a freeway north of Augusta.

Washington County is connected with other Maine points and New England by U. S. Highway 1, which is maintained in excellent year-round condition. Adequate truck transportation to Washington County provides the principal means of movement for most commodities.

Motor-truck transportation in Maine can be expected to increase slowly during the study period. Truckers should participate in any growth of traffic and secure a larger share of total tonnage, particularly in the movement of agricultural commodities. As road improvements provide faster transit between northern Maine points and New England market centers, highway transportation can be expected to divert some traffic from the railroads. The national tendency toward fewer, but financially stronger and larger, motor carriers will be observable in Maine.

IX. BANKING AND FINANCE

A. FINANCIAL INSTITUTIONS

The total assets of all Maine banks (including national banks, federally chartered savings and loan associations, and all state chartered banking institutions) totaled over $1.1 billion as of June 30, 1956. According to information compiled by the Board of Governors of the Federal Reserve System, as of December 31, 1957, Maine had 57 commercial banks with $589 million in deposits and $303 million in loans outstanding. In addition, Maine's 32 mutual savings banks had deposits totaling $352 million and loans outstanding in the amount of $172 million. There are 34 savings and loan associations and cooperative banks in Maine with share capital totaling $62 million and loans of $67 million, as of December 31, 1956.

Bank assets are concentrated in Portland, Augusta, and Bangor; over 50% of total banking assets are located in these three cities. The concentration of assets is offset, however, by the practice of branch banking within the state. The major banks, primarily those located in the above three cities, maintain a total of 70 branches and agencies throughout the state.

The total assets of Maine banks and comparisons with equivalent U. S. figures are shown in Tables LXIX and LXX.

The state's largest single financial institution is the Union Mutual Life Insurance Company of Portland. (See Table LXXI.) As of December 31, 1956, this company had $91,447,000 in admitted assets. Of the 40 odd casualty and fire insurance companies in Maine, the largest is the Maine Bonding and Casualty Company of Portland, with admitted assets of $4,381,000 at the end of 1956. Most other insurance companies in Maine are extremely small by nationwide standards.

A continued shortage of capital for business loans constitutes an impediment to development within the state. This shortage is caused primarily by the low level of savings which, in turn, is the result of low income levels. To some degree, financial practices within the state are also responsible for the capital shortage. Only 22% of the 1957 bank loans in Maine were extended to industrial or commercial borrowers, compared with 35% in the United States as a whole.

TABLE LXIX

ASSETS OF MAINE FINANCIAL INSTITUTIONS, AS OF JUNE 30, 1956
(thousands of dollars)

National Banks (U. S. Chartered)	307,275	
Savings & Loan Associations (U. S. Chartered)	16,824	
Total Federal Charters		324,099
State Institutions		
Trust Companies	326,050	
Savings Banks	373,500	
Savings & Loan Associations	55,926	
Loan Companies	18,207	
Credit Unions	3,350	
Industrial Banks	2,129	
Total State Institutions		779,162
Total Assets in Maine		1,103,261

TABLE LXX

ASSETS OF ALL OPERATING BANKS

	Maine			United States		
	1957	1956	1955	1957	1956	1955
Total Assets (Millions)	$1,021	$1,008	$953	$242,629	$238,128	$229,626
Total Investment (Millions)	425	451	450	85,942	85,547	92,897
Total Loans and Discounts Not Adjusted	473	433	380	113,308	107,092	92,681
Percent of Total Loans and Discounts:						
Commercial and Industrial	22%	23%	23%	35%	34%	31%
Agricultural	2	2	2	4	4	5
Security Margin Accts.	1	1	1	4	4	5
Real Estate	56	55	54	38	38	39
Other Loans to Individuals	18	18	19	17	17	18
Other Loans	2	2	2	3	3	3
Rank of Maine Among States as to Total Bank Assets	36th	36th	36th			

Note: Because of rounding, totals may not add up to 100%.

TABLE LXXI

MAINE INSURANCE COMPANIES, 1956 ASSETS
(thousands of dollars)

Union Mutual Life	91,447
Maine Bonding & Casualty Co.	4,381
All Others	2,698
Total	98,526

Source: Maine Banking Commission

The percentage of industrial and commercial loans is low because: (1) Maine's major companies can obtain funds elsewhere; and (2) the relatively small size of Maine's banks limits their lending capacity.

A comparison of selected types of per-capita savings for 1956 was obtained from the Federal Reserve Bank of Boston:

	United States	New England	Maine
Commercial Bank Time Deposits	$309	$214	$262
Mutual Savings Bank Deposits	177	827	369
Savings & Loan Associations	220	230	68
Life Insurance Equities	460	525	358
New Purchases of Life Insurance	209	236	186

B. DEVELOPMENT CREDIT CORPORATION

A limited source of funds for Maine firms has been the state's Development Credit Corporation. This organization was established in 1949 to provide loans to firms otherwise unable to obtain financing. Fifty-seven banks in the state have contributed and/or pledged capital to the extent of $938,000.

In the eight years of its operation, the Corporation has granted 55 loans totaling $1,648,000. The average loan has amounted to slightly less than $30,000; nine of the loans were for $75,000, the largest amount loaned to a single firm; 13 were $5000 or less, the smallest being $2000. Terms of the loans varied considerably, some of them running for a period of more than 10 years. The Corporation's Annual Report for 1957 stated that the interest rate had been raised from 6% to 7%.

Both old and new firms have received credit even though loans have been granted only to manufacturers or processors. Of 25 loans (totaling $985,650) still active, eight have gone to the wood and wood-products industry; they account for $258,000, or 26% of the total. Four loans were made to the shoe industry in the amount of $275,000, or 28% of the total.

Of 245 applications for loans received since the Corporation's inception, 171 have been denied. Losses and charge-offs have amounted to 2.5% of all loans made, although some of these are being recovered.

Although the Corporation has made loans to a variety of firms and industries located throughout the state, its limited resources and tight credit policy have prevented it from becoming a major provider of credit.

C. INDUSTRIAL BUILDING AUTHORITY

Maine has recently established an Industrial Building Authority, whose purpose is to guarantee the loans of local development groups that are to be used for the construction of industrial facilities. The state's credit may be pledged up to a total of $20 million for this purpose. It is too early to judge the results of this effort. The Department of Economic Development reports that 81 cities and towns in Maine have shown interest in the opportunities thus provided. The fact that only public organizations and not private individuals or firms can obtain state guarantees may limit the effectiveness of the measure.

X. ELECTRIC UTILITIES

Total generating capacity of electric utilities in Maine increased from 415 megawatts at the end of 1950 to about 700 megawatts by the end of 1957, an increase of almost 70% in 7 years. This period witnessed a significant shift from hydroelectric to steam power, since many of the better hydro sites have already been developed. In the period under discussion, steam capacity almost tripled while hydro capacity was limited to a 30% gain. Although hydro capacity still accounted for more than half of the state's total in 1957, additions to generating capacity will henceforth be concentrated in steam electric plants (see Table LXXII).

The total energy generated by electric utilities in Maine increased approximately 48% between 1950 and 1957. The shift toward steam capacity is once again evident. The over-all gain of 48% in Maine compares with an 83% increase for the entire country. Excluded from the above figures are generating capacity and energy output of plants owned by industrial companies in Maine. This industrial capacity at the end of 1955 totaled approximately 306 megawatts, or 33% of combined utility and industrial capacity at that date. The expansion of industrial power plants or the construction of new plants takes place only when this method of obtaining power is more economical than purchasing it from utilities. Past experience indicates that growth of nonutility generation is slow and irregular.

The total number of customers served by electric utilities in Maine increased roughly 6% between 1952 and 1957. (See Table LXXIII.) Total energy sales to ultimate customers increased 40% during the same five-year period. There were significant shifts among the various customer classifications within this period. For example, residential and rural sales increased about 60%, while sales to industrial customers increased 30% and sales to commercial users increased only 22%. Thus, the proportion of total sales to residential and rural customers rose from 33% in 1952 to over 37% in 1957. During the same period the proportion of the total accounted for by industrial sales fell from 45% to 42%. Total electric revenues from ultimate consumers increased approximately 43% between 1952 and 1956.

The three largest utility companies in Maine are the Central Maine Power Company, Bangor Hydro-Electric Company, and the Maine Public Service Company. In 1956 these firms accounted for approximately 89% of total electric utility customers, 94% of energy generated, and 92% of electric revenues of utilities operating in Maine. In 1955,

revenues derived from energy sales to residential and farm customers accounted for 47.4% of Central Maine's annual income, 54.1% of Bangor Hydro-Electric's, and about 50% of Maine Public Service's. Table LXXIII-c shows that residential and rural sales are important to Maine's utilities because several of the state's leading industrial establishments generate their own power.

With respect to the three principal electric utilities in Maine, gross investment in utility plants has increased roughly 33% from 1952 to 1956. Average usage per residential and rural customer of these companies showed a gain of nearly 40%. While the rate of growth in this respect closely parallels the experience of electric utilities serving most other parts of the United States, the absolute level of usage in Maine remains well below the U.S. average. For example, the 1956 average residential usage for these three companies was about 2600 kilowatt-hours, compared with an average of 2960 for the electric utility industry as a whole. Average revenue per kilowatt-hour sold to residential and rural customers in Maine fell from about 3.3¢ to 3.1¢ between 1952 and 1956. For the average U. S. electric utility the 1956 figure was 2.6¢. (See Table LXXIV.)

TABLE LXXII

POWER DATA FOR MAINE UTILITIES

	1950	1952	1954	1956	1957
Generating Capacity[1] (nameplate thousands of kw at year end)					
Hydro	270	269	321	350	351
Steam	118	182	193	245	305
Internal Combustion	27	26	26	42	42
Total Capacity	415	477	540	637	698
Energy Generated[1] (millions of kwh)					
Hydro	1,279	1,363	1,720	1,684	1,474
Steam	350	494	391	741	948
Internal Combustion	51	46	26	66	68
Total Generated	1,680	1,903	2,137	2,491	2,490

1. In 1957 government and co-op owned plants accounted for less than 1% of indicated utility hydro and steam capacity and generation; these same plants accounted for approximately 40% and 70% of utility internal combustion capacity and generation, respectively.

Source: Electric Council of New England.
Edison Electric Institute.

TABLE LXXIII

ELECTRIC CUSTOMERS, SALES AND REVENUES OF PRIVATE AND PUBLICLY-OWNED UTILITIES IN MAINE

	1952	1955	1956	1957
a. Ultimate Customers at Year End (thousands)				
Residential and Rural	280	293	297	300
Commercial	39	40	40	40
Industrial[1]	4	3	3	3
Street Lighting (hundreds)	541	575	583	593
Other[2]	3	3	3	3
Total Ultimate Customers	326	339	343	347
b. Energy Sales to Customers (millions of kwh)				
Residential and Rural	511	704	764	814
Commercial	262	286	308	319
Industrial[1]	701	840	898	919
Street Lighting	20	22	24	26
Other[2]	51	64	71	87
Total Energy Sales	1,545	1,916	2,065	2,165
c. Electric Revenues from Customers (millions of dollars)				
Residential and Rural	17	23	24	25
Commercial	8	9	10	10
Industrial[1]	8	10	11	12
Street Lighting	1	1	1	1
Other[2]	1	1	1	2
Total Electric Revenues	35	44	47	50

1. 50 or more kw of demand.
2. "Other" includes railroads, public authorities and interdepartmental.

Source: Electric Council of New England.
Edison Electric Institute.

TABLE LXXIV

STATISTICS OF THE PRINCIPAL ELECTRIC UTILITY COMPANIES OPERATING IN MAINE[1]

	1952	1953	1954	1955	1956
Average kw hours used per residential customer[2]	1857	2037	2239	2428	2602
Average revenue per kwh sold to residential customers[2] (cents)	3.3	3.2	3.2	3.2	3.1
Gross investment in electric utility plants[3] ($ millions)	205.0	220.0	240.5	257.7	274.2

1. Central Maine Power Co., Bangor Hydro-Electric Co., Maine Public Service Co.

2. Includes rural customers.

3. Includes minor intangibles and construction work in progress. Also included are properties of Maine Public Service Co. in New Brunswick ($3.5 million in 1956).

Source: Annual reports of companies.
Moody's Investors Manual.

XI. RECREATION AND TOURIST INDUSTRY

The methodology for measuring the economic impact of recreation upon local and state economies is not well developed. Nor has any one definition of recreation as a human activity been widely accepted. If recreation is taken to mean "the use of leisure time," which includes many sedentary activities as well as travel and outdoor recreation, then it is particularly difficult to find matching statistical classifications. Expenditures for summer cottages, for example, are for recreation in this sense; so are expenditures for certain kinds of clothing and equipment and for food eaten on a vacation trip. Yet in statistical compilations no distinction is made between the purposes for which these expenditures were made.

Because of this difficulty, any evaulation of recreation and its impact on a region's economy must necessarily be subjective. It must rely on simple physical counts of various recreational activities rather than on breakdowns of consumer expenditures.

A. FACTORS INFLUENCING RECREATION AND TOURISM

Several social and economic factors--population, income, leisure, and especially mobility--affect recreation in any part of the nation. Some of these forces are not felt so strongly in Maine as in the rest of the country, but since the state's vacation and tourist industry depends largely on the patronage of out-of-state travelers, national trends are of significance in this survey.

1. Larger Population

With its variety of scenic attractions and natural resources, Maine appeals principally to those seeking nonurban, outdoor types of recreation. The more people in the country, the greater, obviously, the demand for outdoor recreation. National growth of population has been subject to periodic variations, particularly in recent decades. So far the 1950's, with an annual rate of growth of about 1.8%,have been outrunning earlier periods. Age distribution has also changed; today, there are more older people in the United States, and the proportion of younger age groups is also rising. Moreover, there are indications that our basic tastes are changing toward greater appreciation of the natural environment, especially among the 58% who live in metropolitan areas.

2. Higher Per-Capita Income

Per-capita income also affects recreation. In general, the higher a family's income, the larger the percentage spent on recreation within its broadest definition. (See Table LXXV.) Any further increases in per-capita real income among the 86% of U. S. households with current annual incomes under $7000 are likely to bring about an even faster growth in recreational expenditures.

3. More Leisure

The amount of leisure available to the average person is still rising rapidly, thanks to the shorter work week and longer paid vacations. The Department of Labor has estimated that 62% of all American families now take vacations. Between 3.5 and 5 million people per day travel for pleasure in the United States.*

TABLE LXXV

AVERAGE ANNUAL HOUSEHOLD EXPENDITURE ON RECREATION BY ANNUAL HOUSEHOLD INCOME, 1956

Annual Household Income	Dollars	Percent of Total Expenditures	Percent of U. S. Households
Under $2,000	98	8	18
$2,000 - $2,999	138	9	14
$3,000 - $3,999	192	14	15
$4,000 - $4,999	233	20	19
$5,000 - $6,999	256	24	20
$7,000 - $9,999	322	14	9
$10,000 or more	513	11	5

Average U. S. Household: 215

Source: Life Study of Consumer Expenditures, 1957.

* Your Community Can Profit from the Tourist Business, U. S. Dept. of Commerce, 1957.

4. Greater Mobility

Americans are now more mobile than in earlier years. The miles traveled per average person have increased tenfold since 1900; part of this increase is for business, but a large part is for recreation. By 1970, tourists will drive much farther than the present 350 miles each way and 300 miles at the vacation point (a U. S. Department of Commerce estimate) because of better cars and better roads. Increased mobility has obviously enlarged the area within which people can enjoy their recreation; in this sense, it has increased the supply of recreational areas and led to increased competition for the tourist dollar.

The impact of each of these four factors--more people, higher per-capita income, more leisure, and more mobility--cannot be measured, but it is important to realize that all four have been operating in the same direction and will continue to increase recreation.

B. MAINE'S VACATION BUSINESS

The vacation business has long been an important buttress of the economy of Maine. According to the Recreation Division of the Department of Economic Development, gross income from the state's vacation travel business rose from $135 million in 1950 to $272 million in 1957. In 1954, when the Recreation Division's estimate of gross income from travel stood at $225 million, it represented about 8% of Maine's total income payments, computed by the Maine College Community Research Program. The New England Council, on the other hand, estimated that the vacation business constituted 13% of the state's total income payments in 1950. Differences in the statistical definition of this sector of the economy discourage any comparison of these and other estimates.

Maine's endowment as a vacation center has been adequately described in other publications.* Evidence of ever-growing interest in the state's recreational resources is provided by visitor attendance records at state and federal parks in recent years. In the state parks

* New England Council, The Economic State of New England, 1954. New England-New York Interagency Committee, The Resources of the New England-New York Region, 1956.

alone, which provided outdoor recreation for nearly 500,000 visitors in 1955, visitor use is increasing at the rate of 30-40,000 a year.* At Acadia National Park, visitor attendance in 1956 was 735,000, an increase of 80,000 over the previous year and a 100% increase over 1946. (See Tables LXXVI and LXXVII.) Similarly, between 1946 and 1956, the number of fishing licenses sold to nonresident fishermen in Maine increased by 63%, and the number of hunting licenses issued to nonresident hunters grew by 130%.

C. MAINE'S PROSPECTS

In order to exercise an informed judgment about the future of Maine's vacation industry, we prepared a brief assessment of the factors that would tend to enhance the state's quest for the tourist dollar and of those likely to detract from Maine's competitive position. The following subjective balance sheet was then drawn up.

1. Favorable Factors

a. Continued Increase in Metropolitan Population

In 1950, 55.9% of the country's population lived in standard metropolitan areas. At present rates of growth a possible 66% of the population will reside in standard metropolitan areas by 1975. It is thus quite possible that the population living in the approximately 200 largest standard metropolitan areas in 1975 will be slightly larger than the total U. S. population in 1950. Furthermore, the number of people in the metropolitan areas of northeastern United States will increase from 32 million in 1950 to 44-48 million in 1975.** As towns and cities within the standard metropolitan areas continue to coalesce, the demand for weekend and seasonal outdoor recreational facilities and "open space" is likely to increase rapidly. Nearby public facilities will undoubtedly be crowded not only because of the increased population density and additional leisure time but also because of further closing off

---

* A Recreation Plan for Maine, 1956. Prepared by the Maine State Park Commission in cooperation with the National Park Service. The "number of visitors" is not the same measure as the "number of guest days" listed in State Park Statistics, a publication of the National Park Service.

** Donald J. Bogue, editor, Applications of Demography; The Population Situation in the U. S. in 1975, Scripps Foundation for Research in Population Problems, 1957.

TABLE LXXVI

TOTAL ATTENDANCE AT STATE PARKS
(Thousands of Guest Days)

State	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	% Growth 1946-1956
Maine	67	146	163	252	230	278	334	389	421	419	451	573
New Hampshire	664	875	1,057	1,400	1,805	2,104	1,941	1,925	1,916	2,157	2,203	232
Vermont	161	256	n.a.	n.a.	n.a.	328	436	433	408	501	443	175
United States	92,506	109,996	105,249	106,784	114,288	120,720	149,258	159,111	166,422	183,189	200,702	117

Source: National Park Service, State Park Statistics.

TABLE LXXVII

TOTAL ATTENDANCE AT NATIONAL PARKS
(Thousands)

State	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	% Growth 1946-1956
Acadia	382	434	421	439	485	519	549	556	554	655	735	92
United States	8,991	10,674	11,293	12,968	13,919	15,079	17,143	17,372	17,969	18,830	20,055	123

Source: U. S. Department of the Interior, National Park Service.

of metropolitan beaches, lakeshores, and suburban countryside for private use. Maine's opportunity to provide these facilities to residents of the Boston-Washington urban region has been recognized by the State Park Commission, which estimates that accommodations for well over a million visitors (more than twice the 1956 total) will be needed in the state park system by 1966.* Since Maine has the largest acreage of state parks per capita of state population, it is safe to assume that an increasing number of visitors will come from outside the state. This trend is confirmed by the last column of Table LXXVI, which shows that attendance at Maine state parks has risen about five times as fast as attendance at other state parks throughout the country, and much faster than in Vermont and New Hampshire, where outdoor recreation facilities are already more fully developed.

b. Existence of Wilderness Areas

This asset is rapidly vanishing in most parts of eastern United States. Some of the largest remaining tracts of mountain, forest, and lake wilderness in the East are found in Maine. The demand for wilderness recreation areas is rising even as more accessible facilities are developed for camping, picnicking, and other sedentary recreation. Maine is in the fortunate position of offering both kinds of outdoor recreation. It issues more nonresident hunting licenses than any other Eastern state except Pennsylvania, and more nonresident fishing licenses than any other New England or Middle Atlantic state. The wilderness areas are Maine's best promise for lengthening the tourist season beyond the summer months.

c. Potential Increase in Number of Canadian Tourists

Not only is the population of Canada as heavily urbanized as that of the United States, but its postwar rate of increase of both total and urban population has exceeded the U. S. rate of growth. Montreal is one of the fastest-growing metropolitan centers in North America. For about one-third of Canada's population, the coasts of Maine and New Hampshire are the nearest and most convenient outlets to the sea. The opportunities for northern New England to attract more Canadian business thus seem very great, particularly as Canadian per-capita income approaches U. S. levels.

---

* A Recreation Plan for Maine, 1956.

2. Potentially Unfavorable Factors

a. Length of Vacation Season

While in the United States as a whole about 40% of all vacations are taken in summer, almost 70% of Maine's vacation business is concentrated in the months of July and August.* (See Table LXXVIII.) There is clearly a serious operating disadvantage in having a two-month season support year-round, fixed operating costs. To compensate for this, operators must either charge higher rates or offer poorer facilities and service. Neither alternative is an inducement to the tourist trade.

TABLE LXXVIII

PERCENTAGE OF VACATION LODGING BUSINESS DONE IN EACH MONTH

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Maine	.28	.41	.25	.95	3.96	8.97	32.05	35.80	11.29	3.89	1.80	.35
New England	1.22	1.71	1.05	1.28	3.22	8.94	29.72	34.31	11.72	4.41	1.39	1.03
United States		17			18			40			25	

b. Inroads of Winter Vacation and Extended Tourist Season in Other Areas

More and more Americans are taking two vacation trips a year.** Florida and other southern winter-vacation areas compete indirectly with Maine insofar as they reduce the length of tourists' summer travel. Besides, in many areas the tourist business has become a year-round business. As a result of skillful promotion, price adjustments, and planned attractions, Florida has succeeded in developing a substantial tourist business in the summer; moreover, in many northern areas, skiing and other winter sports also compete with the traditional summer season. Maine, on the other hand, is not likely to have more than limited success in breaking through the weather barrier.

---

* The Travel Market, Curtis Publishing Co., 1955, p. 17; The Economic State of New England, p. 233.

** The Tourist Business, 1957.

c. Effect of Increased Mobility

In 1955 it was estimated that the average tourist drives a total of about 1000 miles on a vacation trip. By 1970 he is likely to cover 50% more mileage to and from his destination. Moreover, jet travel will increase interregional tourist traffic (especially between the principal urban centers of the nation) and foreign competition for the American tourist.* Although increased mobility undoubtedly places a larger share of North America's tourists within range of a Maine vacation, the same factor also works against the sedentary type of holiday on which Maine's tourist business was originally built up. For vacation tours (unless the Maritime Provinces and Quebec are included in the circuit) Maine's marginal location is a distinct disadvantage which completion of the interstate highway network will diminish but not eliminate.

Overall, the vacation and recreation business in Maine is likely to grow more rapidly in the less developed lake, mountain, and wilderness areas of the interior than in the traditional seashore resorts. The seasonal and locational disadvantages of Maine's recreational resources are likely to be counterbalanced by increasing "open space" needs for weekends and short vacations within easy reach of the Atlantic seaboard's surging metropolitan populations.

Assuming that the population of the standard metropolitan areas of the Northeast will grow 2% per year, that real per-capita income will increase 2%, and that Canadian patronage will continue to grow as a result of improved tourist promotion and expanded public recreation facilities, we feel confident in projecting an annual increase of 5% in Maine's tourist business. This equals the growth of the national tourist business between 1953 and 1956, and represents the extrapolation of a five-year trend of out-of-state tourist expenditures in Maine. (See Table LXXIX.)

D. THE TOURIST INDUSTRY IN WASHINGTON COUNTY

With more than 130,000 acres of lakes, excellent fishing streams, 1.5 million acres of woodland for camping and hunting, and a picturesque coastline, Washington County is well endowed with recreational resources. In 1957, income from the tourist business was estimated at $4,380,000, which represents about 1.6% of Maine's tourist

---

* The Tourist Business, 1957.

TABLE LXXIX

OUT-OF-STATE TOURIST EXPENDITURES IN MAINE AND IN SELECTED VACATION TRAVEL STATES, 1951-1955
(Thousands of Dollars)

	1951	1952	1953	1954	1955	% Increase 1951-1955
Maine	150,000	175,000	181,000	185,000	193,125	28.7
Florida	912,000	920,000	930,000	980,000	1,000,000	9.7
Michigan	488,000	500,000	501,800	502,150	542,172	11.1
Massachusetts	228,000	234,000	241,000	244,200	253,900	11.0
New Hampshire	125,000	128,000	140,000	175,000	178,000	42.4
Minnesota	147,000	150,000	154,000	156,000	163,000	10.9

Source: National Association of Travel Organizations.

income in the same year. Clearly, Washington County (with more than 3% of the state's population and 8% of its area) has not exploited its tourist potential to the fullest, in view of the fact that Acadia National Park, in adjacent Hancock County, is a major tourist attraction of the northeastern United States. (More than 700,000 visits were recorded in 1956.)

All but a small fraction of tourists enter Maine from the west and southwest. It is safe to assume, therefore, that Washington County will not draw a larger share of tourists into the southeastern corner of the state unless it offers tourist attractions over and above the usual commercial facilities.

The Maine State Park Commission has outlined a long-range program for expanding the system of public parks and recreation facilities in an effort to meet the rapidly increasing needs for nonurban recreation in Maine. While the greatest emphasis has been given to the establishment of new areas in southwestern Maine, where most of the state's population is concentrated and the tourist traffic is heaviest, the plan also provides for the development of additional areas in the east, including two state parks in Washington County. The cost of acquiring land and developing camping and fishing facilities in the wilderness setting of the Grand Lakes Area and beaches in the Roque Island Group has been estimated at a little over $500,000. Development of these and other areas within easy reach of U. S. Highway No. 1 would provide an important additional attraction for tourists considering a visit to the Passamaquoddy dams and powerhouse.

It is difficult to anticipate the recreational benefits of an engineering project for which there is no precedent in the United States. Moreover, an important element in the assessment of such benefits is the extent to which federal, state, and local agencies would develop outdoor recreation facilities in the vicinity of the project. In order to arrive at an order-of-magnitude estimate of tourist interest in major engineering and water-development installations that are beyond easy reach of large metropolitan areas, we have selected attendance figures at Hoover and Grand Coulee Dams. Neither of these installations is located near a large city or on a major traffic route. It should be noted, however, that both of these projects created large reservoirs in sections that were lacking in natural lakes. These lakes have afforded recreational opportunities that seem to attract larger numbers of tourists than the engineering structures themselves. Both the Grand Coulee and Lake Mead Recreational Areas are administered by the National Park Service, which provides excellent tourist facilities. Furthermore, Hoover Dam

benefits from the proximity of another tourist attraction--Las Vegas, Nevada. Davis Dam, downstream from Hoover on the Colorado River and farther from Las Vegas, draws relatively few people.

	Grand Coulee	Hoover
Visitors who toured powerhouse in 1957	129, 511	460, 994
Visitors at adjacent recreation areas, 1957	266, 863*	2, 955, 257

We therefore estimate that the existence of a tidal power project at Passamaquoddy is likely to attract: (1) most tourists traveling along Highway 1 between Maine and the Maritime Provinces,** if only for sightseeing and a meal stop, and (2) about 25% of all visitors to Acadia National Park who would not otherwise continue their circuit beyond Hancock County.

The length of the visit would depend upon the availability of recreational facilities in the vicinity of the project. Depending on the nature of these facilities, Passamaquoddy would also become the destination of recurring visits by the 500, 000 people residing within 100 miles of the project area.

---

* The Coulee Dam Recreation Area is not fully developed; the National Park Service anticipates annual attendance of one million visitors upon completion of facilities.

** According to the Immigration and Naturalization Service, about 75% of all border crossers at Calais, Maine (U. S. Highway 1), during the busiest months (June, July, August) were not local and immediate area residents. This would mean that almost 200, 000 potential non-local visitors travel through Washington County during an average summer month.

Monthly average of border crossers at Calais, Maine, during busiest months:

Fiscal Year	Aliens	U. S. Citizens
1956	148, 100	87, 000
1957	151, 500	83, 000
1958	146, 400	92, 500

PART TWO

INTEREST OF SELECTED INDUSTRIES IN PASSAMAQUODDY POWER

I. INTRODUCTION

We investigated a total of 18 "target" industries to ascertain whether they might be attracted to the Passamaquoddy area by the availability of low-cost power or the combination of power with other favorable locational factors.

Of the 18, most of which are electroprocess industries, 13 would not be attracted to the area by the availability of electric power at any economic rate. The reasons are diverse, but in most cases the area's comparative remoteness from major markets and/or raw materials would make a Passamaquoddy-based operation noncompetitive. Table I lists this group of industries together with the adverse locational factors which preclude their establishment in Maine.

Our survey reveals that five industries might be interested in locating at or near the project site if power in sufficient quantity were available at a maximum rate of 3.5 mills per kilowatt hour at source. These industries are: aluminum, ferroalloys (especially manganese), high-energy fuel, lithium metal, and silicon carbide. It should be noted that the list includes two products--high-energy fuel and lithium--whose future will be shaped by technological and defense considerations of a classified nature. It would therefore be idle to predict the capacity and labor requirements of such plants or to project the share of Passamaquoddy power that might be allocated to them 10 or more years hence.

The energy requirements and effect on employment of potential aluminum, manganese, and silicon carbide plants at Passamaquoddy are shown in Table II. It may be noted that an aluminum plant with an annual capacity of 75,000 tons (not a large plant, even at the present stage of development) would have a firm annual energy requirement in excess of what the tidal power project could deliver to the American side. The availability of lower-cost interruptible power would perhaps be a locational factor for some of the other industries considered here, notably those for which a Maine location would provide other advantages in addition to a cheap power supply.

We conclude further that if the minimum cost at which Passamaquoddy power becomes available is 4.0 mills per kilowatt-hour, the list would shrink to a point where power alone would no longer attract industries to the site. Although the production of ferroalloys (especially manganese) might still be competitive at a power cost of 4 mills per kilowatt hour, the decision to locate such a plant near Passamaquoddy under

TABLE I

ELIMINATED TARGET INDUSTRIES

Industry	Locational Factors Preventing Development at Passamaquoddy (in order of importance)
Magnesium	Difference in cost of fuel and limestone; higher capital costs due to Maine's harsher winter climate than the Gulf Coast's
Lead	High fuel costs; low electric-power requirements
Zinc	High fuel costs
Copper	Lack of sufficiently large power reserves; electric power a minor locational factor
Iron and Steel	Distance from market and raw materials
Hydrogen Peroxide	Technological change eliminates power as a locational factor
Elemental Phosphorus	Distance from raw material and market
Sodium Metal	Distance from market and raw materials
Chlorine and Caustic Soda	Distance from markets
Fluorine	Distance from raw materials
Chlorates and Perchlorates	Distance from markets and raw materials
Calcium Carbide	Distance from raw materials and markets
Rayon	Distance from market; uncertain future of industry

those conditions is likely to be based on technological factors that would bring the low-grade manganese deposits of Maine and New Brunswick within reach of commercial exploitation. The outlook for this technologic breakthrough is uncertain at present. (See Part Two Section IV-E-1.)

TABLE II

NEW ELECTROPROCESS INDUSTRIES AT PASSAMAQUODDY WITH POWER AT 3.5 MILLS PER KILOWATT HOUR--1970

	Annual Plant Capacity (tons)	Annual Energy Requirement* (megawatt hours)	Average Annual Employment	
			Direct Employment (production workers)	Ancillary Employment**
Aluminum	75,000	1,350,000	800	560
Manganese	20,000	200,000	250	170
Silicon Carbide	10,000	75,000	100	70

* At 80% load factor.

** Using a multiplier of 1.7 (i.e., each manufacturing job creates 0.7 job in service industries).

We finally conclude that there would be no interest whatsoever in a Passamaquoddy location if the power cost were in excess of 4.0 mills per kilowatt-hour.

II. ALUMINUM

Historically, the aluminum industry has been characterized as a growth industry. Prior to World War II, under monopoly conditions, the market was rigidly controlled and consisted mainly of kitchen utensils and a few novelty applications. During World War II, the explosive military demand for aluminum (chiefly for aircraft) completely altered the industry because:

1. It was indirectly responsible for breaking the monopoly;

2. It established aluminum as a structural material; and

3. It resulted in a quadrupling of the available supply within three years.

In the ensuing years, aluminum more than shared the growth enjoyed by the total economy.

Between 1946 and 1958 the number of established producers grew from two to five; the number of plants increased from 9 to 19; the annual reduction capacity grew from less than 700,000 to more than 1.9 million tons; and the total market expanded from less than 500,000 tons to almost 2 million tons.

Since World War II, the Government has been a major factor in the primary aluminum market. Thanks to the national aluminum stockpile, the industry has been able to operate at levels frequently in excess of the needs of the commercial market. In 1954 and 1957, both "off years," Government stockpile purchases were very substantial. In 1958, however, the stockpiling requirements will virtually have been satisfied, and the Government's obligation to purchase large quantities of "distress metal" will terminate.

TABLE III

U. S. PRODUCTION AND COMMERCIAL SHIPMENTS OF PRIMARY ALUMINUM, 1954-1957

	1954	1955	1956	1957
	----- (thousands of tons) -----			
Domestic Primary Production	1462	1566	1679	1648
Total Shipments of Primary (est)*	1200	1600	1650	1550
Less Imports	222	198	231	225
Estimated Commercial Shipments by U. S. Producers	978	1402	1419	1325

	1954	1955	1956	1957
	---- (thousands of dollars) ----			
Value of Estimated Commercial Shipments by U. S. Producers	450	660	680	670

* Includes direct military sales, but excludes shipments to national stockpile.

Source: U. S. Department of Commerce.

Aluminum's principal markets in recent years may be grouped into the following categories:

	Approximate Percentage of Total Market
Building Industry	20
Transportation Equipment	14
Electrical Industries	11
Consumer Durable Goods	12
Packaging and Containers	5
Direct Military	10

Presently, three completely integrated producers together control 89% of the U. S. aluminum reduction capacity. (See Table IV.) In addition, two independents are now operating reduction facilities, and a third is scheduled to be in operation by 1960.

The geographical distribution of these plants, shown in Figure 1, has been dictated entirely by the availability of economical power sources.

A. EXPECTED GROWTH TO 1970

The outlook for expansion of the industry is primarily influenced by three circumstances:

1. The growth anticipated for the economy as a whole;

2. The industry has become competitive in a very real sense; the appearance of new producers, together with the withdrawal of the Government as a major factor in the market, has stimulated the search for new applications and new markets, including those overseas;

3. There is no foreseeable prospect for materially altering the price relationship with ferrous metals and synthetic nonmetallic materials.

TABLE IV

U. S. PRIMARY ALUMINUM PRODUCERS, 1958-1960

	Number of Plants	Estimated Percentage of Total Capacity	
		1958-1959	1960
Aluminum Company of America	7	37	39
Kaiser Aluminum & Chemical Corp.	4	26	23
Reynolds Metals Company	6	26	27
Anaconda Aluminum Co.	1	3	2
Oremet, Inc.*	1	8	7
Harvey Machine Co.	1	**	2

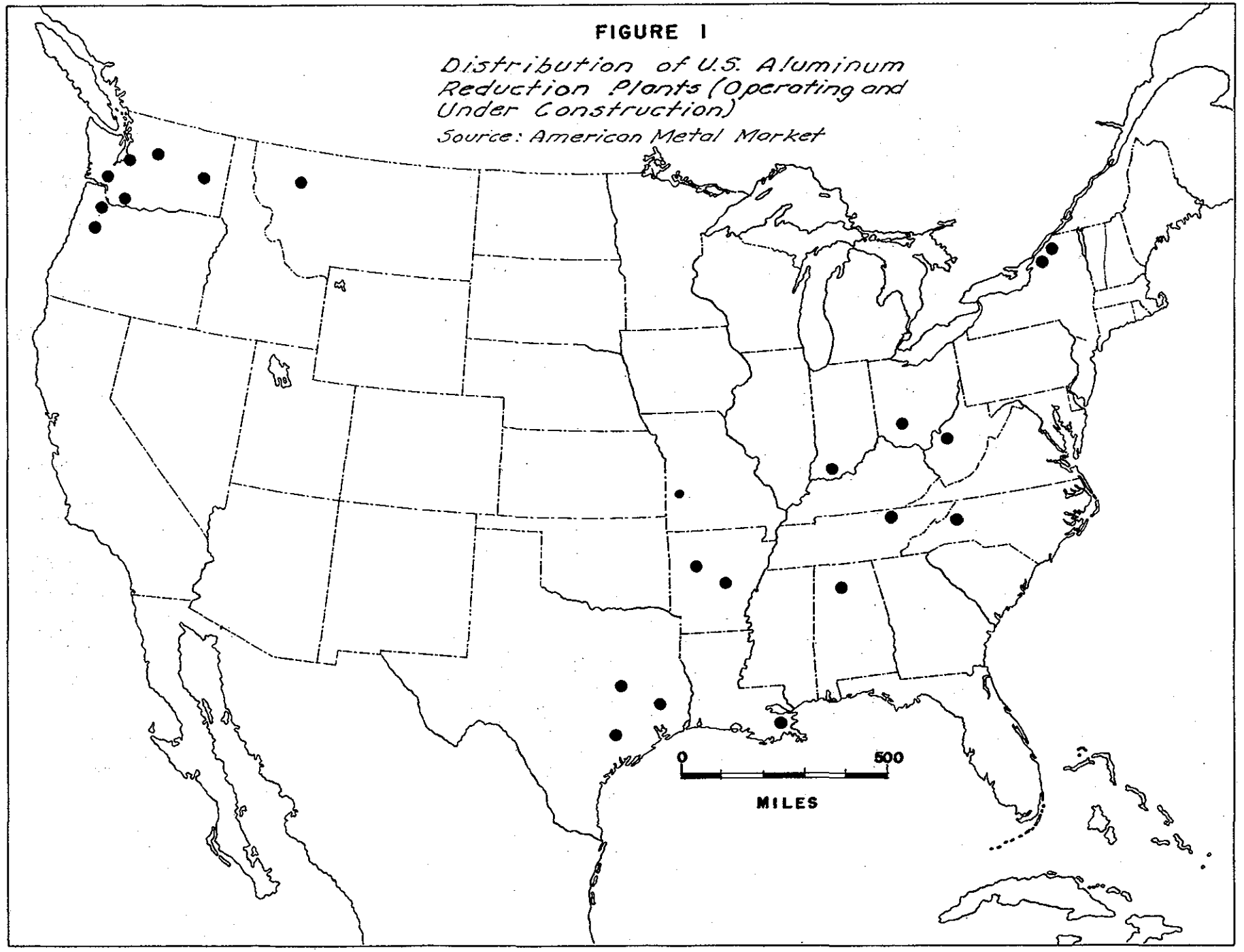
* Jointly owned by Olin Mathieson Chemical Co. and Revere Brass and Copper Co.

** Under construction.

FIGURE 1

Distribution of U.S. Aluminum Reduction Plants (Operating and Under Construction)

Source: American Metal Market



Barring unpredictable changes in the technology of aluminum reduction, which would narrow the aluminum-steel price gap, or the unlikely development of very high-temperature-resistant aluminum alloys, the principal fields of application are known. Among these, the greatest expansion in the use of aluminum is expected to occur in building materials, electric power conductors, containers and packaging, and transportation equipment. The industry's hope for future expansion is based on an expected deeper penetration of each of these particular market areas. In most areas, the prospects for doing so are excellent.

The outlook could be changed radically, however, by at least two potential applications now in the experimental stage: (1) the use of aluminum in automotive engine blocks, and (2) a comparatively small penetration into the rigid container market.

If aluminum were to displace cast iron for automotive engine blocks, the quantity of metal required would be equivalent to the annual output of a 150,000-ton reduction plant. While aluminum engine blocks would provide greater operating efficiencies, the relative cost of the two materials precludes forecasting this use.

If the aluminum industry succeeded in capturing only 10% of the rigid-container market, it has been estimated that this use alone would require more than 1 million tons of metal. The economics of this application are so tenuous and the future technology of food preservation so uncertain that it cannot be included in a conservative forecast.

Anticipated developments between now and 1970 should result in the changes shown in Table V.

While the major producers are making strong bids for position in the world market, it is doubtful that success in this direction will materially increase exports during future years. In fact, conspicuous success in entering foreign markets might have the opposite effect, since the trend is for U. S. producers to establish overseas facilities. This trend is likely to be intensified because: (1) the intricacies of foreign import and monetary regulations do not encourage the serving of a large part of the potential foreign market from domestic facilities; and (2) the national policy of countries in which bauxite is presently and potentially available encourages the establishment of reduction facilities at or near overseas sources of bauxite and hydroelectric power.

TABLE V

CHANGES IN RELATIVE IMPORTANCE OF PRINCIPAL ALUMINUM MARKETS

	Approximate Percentage of Total Market	
	1958	1970
Building Industry	20	19
Transportation Equipment	14	15
Electrical Industries	11	17
Consumer Durable Goods	12	10
Packaging and Containers	5	6
Direct Military	10	6
All Others	27	28

Source: Arthur D. Little, Inc., and published statements of aluminum-industry spokesmen.

Weighing all known considerations, we believe that the industry's growth rate between 1958 and 1970 should be appreciably slower than that during the last two decades. At the present stage of development, the industry gives every evidence of stabilizing, barring some unforeseen technological development. Relying solely on the growth potential of the industry's principal known markets and the likelihood of increased penetration in these markets, we believe that the demand for aluminum should expand more rapidly than the total economy during the study period.

We conservatively estimate that the demand for primary aluminum will be 3 million tons in 1965 and 4 million tons by 1970.

1. New Companies

The high cost of facilities and comparatively low return on investment which characterize the aluminum-reduction business discourage newcomers from entering the field. In its effort to foster vigorous competition in the aluminum business after World War II, the Government offered several companies unusual inducements to enter the field. As a result, Kaiser Aluminum became the third producer.

The industry's base was subsequently broadened by major aluminum fabricators that sought an adequate and economical metal supply. Even though each of these new producers is primarily interested in his own metal requirements, these independents, as a group, are a growing factor in the pig and ingot market. It is improbable that any additional fabricators will enter the field because virtually none of those remaining could support what would essentially be captive facilities. This situation could, of course, be modified by an unexpected turn in the market; for example, the use of aluminum for automotive engine blocks, or a singularly successful penetration of the rigid-container market. The more likely development, however, is that the independent producers will find it economic to compete actively in the market for pig and ingot and increase their capacity accordingly.

2. Number of New Plants

Reduction capacity now in place, under construction, and definitely scheduled amounts to 2.6 million tons. Incremental capacity necessary to serve the forecast market in 1965 and 1970 will be 400,000 tons and 1 million tons, respectively.

The significant portion of the 400,000 tons of capacity needed during the first period will probably be supplied by enlargement of existing plants. The 1 million tons of new capacity required between 1965 and 1970 would involve the construction of 4-6 new plants.

B. POWER CONSUMPTION

The average energy requirement for 1 ton of aluminum is 18,000 kilowatt hours at 80% load factor. The total requirement for all reduction capacity now in place, under construction, and definitely scheduled, theoretically amounts to 46.8 million megawatt hours per year.

The new capacity required between now and 1965 will consume 7.2 million megawatt hours annually. This power will probably be supplied from existing sources.

The 1965-1970 incremental capacity will call for a maximum of 18 million megawatt hours per year from new sources.

C. POWER COST AS A PERCENTAGE OF TOTAL COST

For the national average, the cost of electric power represents about 20% of total aluminum-reduction costs. This approximation is based on an average of high- and low-efficiency plants. Moreover, it is known that at various locations the aluminum industry is paying 2.0 - 3.0 mills per kilowatt-hour for hydroelectric power and 3.5 - 3.9 mills per kilowatt-hour for thermal power.

At an appreciable distance from the market center, the industry can afford to pay no more than 2.0 - 2.5 mills per kilowatt-hour; the maximum cost that can economically be borne by a new plant close to the midwestern market is 4.0 mills per kilowatt-hour.

D. EFFECT OF TECHNOLOGICAL IMPROVEMENT ON POWER CONSUMPTION

Research now under way, if successful, could reduce the amount of electric power required for aluminum reduction by one-third. Since the technology involves the introduction of certain elements directly into the reduction pots, it would theoretically be applicable to

old and new plants alike. In addition to its intensive efforts to lower the power requirement of the conventional reduction method, the industry is endeavoring to discover an economical nonelectrolytic, direct-reduction method.

Between now and 1970 the amount of electric power required per ton of aluminum will probably be appreciably less than the present requirement.

E. LOCATIONAL REQUIREMENTS OTHER THAN POWER

In order of importance, the significant locational factors (other than power) for aluminum-reduction plants are proximity to raw material supply and market, and waste disposal.

Since the aluminum industry absorbs freight charges, outbound as well as inbound transportation costs are a major locational consideration.

For practical purposes, there are no available sites at domestic sources of the basic raw material, bauxite. Established and contemplated sources involve long hauls to alumina plants, thence to reduction facilities. Given a choice, industry prefers a site close to the market rather than one closer to sources of alumina.

Waste disposal is a comparatively minor factor in site selection. Although atmosphere contamination is a real problem, it is susceptible to mechanical control.

F. POSSIBLE INTEREST IN PASSAMAQUODDY

It is entirely possible that by 1970, New England's primary aluminum demand will amount to 7% of the national market, or close to 300,000 tons annually. A market of this size could probably support a regional plant of 60,000-100,000 tons annual capacity.

Presently, New England's comparatively small requirement of pig and ingot is adequately served from Ohio Valley and even Gulf plants. The growth anticipated in this segment of the market between now and 1970 would not, of itself, warrant the establishment of a regional reduction plant. Interest in such a facility would probably come from a

major producer. It would stem not so much from a need to serve a minor market with a regional facility, but rather from the opportunity of acquiring an economical hydroelectric-power-based reduction plant. The economics of this approach lie in the fact that the cost of hydroelectric power is somewhat more stable than that of thermal power, regardless of the thermal source. Therefore, producers have been willing to locate and, in recent years, expand hydro-based reduction plants far from principal market centers. All other circumstances being at least equal, this "rule" should apply to Passamaquoddy.

Aside from the cost of power, a reduction plant in Maine would have to compete with those in the Ohio Valley and those which two major producers are scheduling for construction at Massena, New York.

A comparison of transportation costs shows that shipment of aluminum from the Gulf area to Eastport should be slightly less than that to Massena, but slightly more than that to Ohio Valley plants. Outbound freight charges from either Eastport or Massena to New Haven or Bridgeport are the same. From the Ohio Valley, charges are somewhat higher, but they would probably be equalized with Massena if traffic warranted. If a small regional plant shipped exclusively to New England market centers, a Maine facility would be at no disadvantage. However, the assumption is unrealistic; the regional market will be served by all producers, and market fluctuations will necessitate frequent shipments beyond New England--probably to or beyond the New York-New Jersey area. Occasional or sporadic movements from Maine to the mid-Atlantic market would be more costly than those from the Ohio Valley. Moreover, under the competitive pressures that would force a Maine plant into this market, service would be more important and less feasible from the Maine location.

In summary, marketing considerations neither encourage nor preclude the establishment of an aluminum-reduction plant at the project site. Under these circumstances, we believe that a major producer would be attracted to the area by the availability of hydroelectric power at a maximum of 3.5 mills per kilowatt-hour.

III. MAGNESIUM

Magnesium is produced from raw materials that are available in abundance domestically. The present major source of magnesium is sea water. In addition, several magnesium-rich minerals, such as dolomite and magnesite, are available in abundance in this country and could be used as sources of magnesium in the future. In Canada, for example, magnesium is produced from dolomite.

Magnesium has been known as a metal for a long time, but its commercial usage was extremely small until World War I, when production was started in the United States. Several plants were built, but after the war they gradually reduced their output. By 1927, the Dow Chemical Company was the only U. S. producer. During World War II, when large quantities of magnesium were required, 15 new magnesium plants were built; 13 were Government-owned. Once again, demand fell off steeply after the war; and, by 1946, Dow's plant at Freeport, Texas, was the country's only active producer of magnesium. Six of the Government plants were placed on stand-by status, but were started up again during the Korean conflict. Following Korea, Dow again became the only commercial producer.

At the present time, Dow has two important commercial magnesium plants in operation at Freeport and Velasco, Texas. Freeport has a reported capacity of 30,000 tons per year; Velasco, a 45,000-ton capacity. The Velasco plant was acquired by Dow from the Government in November, 1957. It is currently closed down for extensive retooling. The New England Lime Company, which operates a small Pidgeon-process plant in Connecticut, produces a few thousand tons of high-purity magnesium for the Atomic Energy Commission. The magnesium from this plant sells at more than 50¢ per pound, whereas Dow's standard-grade magnesium sells for 36¢ per pound. Titanium Metals Corporation of America operates an electrolytic magnesium plant as part of its integrated titanium-producing facility at Henderson, Nevada. This plant does not produce magnesium for sale on the open market.

Production and shipments of magnesium in the United States for the years 1947 through 1957 are presented in Table VI. The differences between production and shipments in the past few years have been caused by stockpiling by the Government and Dow. With Dow in possession of the Velasco plant and the Government stockpiling program virtually completed, it is expected that production and shipments henceforth will be in approximate balance.

TABLE VI

MAGNESIUM PRODUCTION AND SHIPMENTS
(Net Tons)

Year	Production	Shipments
1947	12,344	5,264
1948	10,003	8,489
1949	11,598	12,977
1950	15,529	20,370
1951	40,881	40,007
1952	105,821	104,914
1953	93,075	90,041
1954	69,729	63,482
1955	61,135	56,171
1956	68,346	63,262
1957	81,263	51,570

Source: Bureau of Mines.

From the annual shipment totals in Table VI, it is evident that there has been a rather steady increase in the demand for magnesium, if allowance is made for the exceptional needs of the Korean War years. Demand has grown from an average of about 10,000 tons per year in the period 1947-1950 to 50,000-60,000 tons in the post-Korean War years. It can be seen from the shipment data that additional magnesium-producing facilities will soon be required. Dow's present capacity is 75,000 tons per year; U. S. consumption is about 50,000 tons. Alabama Metallurgical Corporation has announced plans for building a Pidgeon-process plant in Alabama with an initial capacity of 6000 tons of magnesium per year; it will lend itself readily to expansion to an annual capacity of 12,000 tons. If this plant is built, further additions to magnesium capacity will not be required in the immediate future. However, if magnesium consumption continues to grow as it has in the past, there will be need for further primary-metal facilities beyond those of Dow and those contemplated by Alabama Metallurgical.

A. STRUCTURAL USES

As shown in Table VII, magnesium finds important uses in two primary fields: structural products and nonstructural products.

The growth of magnesium has not been so rapid in structural applications as in nonstructural applications. Its use in structural applications will probably predominate when magnesium reaches the status of an important structural material. In our opinion, the past growth in structural applications is more indicative of future growth than is the past growth in nonstructural uses.

Several steps are being taken to develop the use of magnesium as a structural material, both in castings and in wrought products. In wrought products, the installation of modern rolling mills and extrusion presses is a major step forward. Because magnesium must be worked hot, it is not so easy to fabricate in wrought form as is aluminum. Thus, the need for adequate equipment, coupled with the know-how to operate this equipment, is of particular importance to the magnesium industry.

There has been a rather sharp drop in the tonnage of magnesium castings produced (see Table VII) because aluminum and zinc are readily available for die castings; besides, there has been a marked decrease in the demand for magnesium castings in the newer military aircraft. The B-36 bomber, which was produced in quantity until 1954, was primarily responsible for the large tonnage of magnesium castings

TABLE VII

USE OF MAGNESIUM IN THE UNITED STATES
(Short Tons)

Structural Products	1947-1951	1952	1953	1954	1955	1956	1957
Castings							
Sand	3,836	14,513	14,306	9,545	6,872	6,478	6,076
Die	352	2,777	2,401	1,743	2,619	1,875	1,649
Permanent Mold	257	1,115	1,106	785	876	1,034	571
Wrought Products							
Sheet and Plate	2,717	5,150	5,443	3,033	6,424	5,496	4,916
Extrusions	3,231	2,715	4,744	2,461	4,106	6,223	5,081
Forgings	249	12	24	110	307	473	7
Total	10,642	26,282	28,024	17,677	21,204	21,579	18,300
Nonstructural Products							
Powder	109	1,553	1,219	582	681	918	386
Aluminum Alloys	3,116	8,598	10,347	8,061	11,104	13,323	11,236
Other Alloys	156	960	418	103	364	98	587
Scavenger and Deoxidizer	611	1,229	423	80	654	865	867
Chemical	343	566	363	63	124	63	325
Cathodic Protection	1,003	2,100	2,539	5,479	3,941	3,036	2,997
Reductant for Titanium, Zirconium, Hafnium and Beryllium	--	--	--	6,386	8,056	13,303	9,695
Other	475	1,099	3,510	787	335	425	49
Total	5,813	16,105	18,819	21,541	25,259	32,031	26,142
Grand Total	16,455	42,387	48,843	39,218	46,463	53,610	44,442
Exports	635	1,206	2,970	3,291	8,480	3,931	1,585

Source: Bureau of Mines.

made in 1952-1954. In spite of this recent decline, we expect that the usage of magnesium castings will grow during the next few years. Some of the automotive companies are becoming increasingly interested in magnesium castings; in fact, some are producing cast-magnesium parts themselves.

The uses of magnesium in such products as ladders, chain saws, materials-handling equipment, and printing plates have all been well publicized. All of these represent growth areas. Thus, we expect the use of magnesium in structural products to continue growth at a moderate rate over the next few years. We do not look forward to any unusual increases in demand except in the unlikely event that new uses or new alloys should be developed.

B. NONSTRUCTURAL USES

In the period following World War II, the most impressive gains in the use of magnesium have been made in its nonstructural applications. In this area, the most important advances have been in aluminum alloys, in cathodic protection, and in the use of magnesium as a reductant for such reactive metals as titanium, zirconium, hafnium, and beryllium.

Small amounts of magnesium are added to certain aluminum alloys. Magnesium additions to aluminum tend to make the alloys harder, stronger, and more corrosion resistant. Many of the high-strength aluminum alloys depend upon the addition of minor amounts of magnesium for their high degree of strength. In addition, many of the aluminum alloys destined for applications in a sea-water environment use magnesium. The increasing importance of high-strength aluminum alloys and of aluminum as a structural material in shipbuilding should lead to greater use of magnesium for alloying purposes.

Magnesium is also becoming increasingly important in the cathodic protection of iron and steel. Magnesium anodes are being used to protect pipelines, tanks, and ship hulls. In many of these applications, magnesium recovered from scrap has been used. However, any increase in magnesium demand, even for secondary metal, is of importance to the industry. With the increasing demand for cathodic protection materials, more magnesium will be required.

A new use for magnesium--as a reductant for reactive metals--requires a considerable tonnage. This usage, which reached its peak of over 13,000 tons in 1956 (see Table VII), does not include the magnesium recycled by Titanium Metals Corporation of America or that used by the Atomic Energy Commission for the reduction of uranium. The latter two uses, taken together, amount to perhaps half again as much as the total listed under "reductant" in Table VII. Unfortunately, the recent decrease in the demand for titanium has had an adverse effect on that particular use for magnesium. In the long run, however, we expect the demand for titanium to grow to the point where it uses substantial tonnages of magnesium. In addition, magnesium requirements, which in the past have been limited, as a reductant for zirconium will increase soon. The importance of zirconium to the nuclear industry and to the AEC is well known. New facilities for increasing zirconium capacity severalfold have recently been completed. They will require substantial tonnages of magnesium in the future. If the use of beryllium increases (as many expect it will), it may use significant quantities of magnesium as a reductant. On the whole, the demand for magnesium as a reductant is expected to increase gradually.

With anticipated moderate increases in demand for magnesium in structural and nonstructural applications, additional facilities for magnesium will be required in a few years. The locational requirements of these future facilities must be examined in the light of existing production processes.

C. LOCATIONAL REQUIREMENTS

Since there is little difference in the cost of production of magnesium by either the Dow process or the Pidgeon process, both must be considered in the planning of a new plant.

1. The Dow Process

The Dow process relies upon the electrolysis of magnesium chloride to produce magnesium metal. The chloride can be obtained from sea water, brines, or chlorination of other magnesium compounds. In the past, plants that operated on chlorides obtained from brines have not been competitive with those based on sea water. It seems likely that if future plants based on electrolysis are built, they will utilize sea water as the source of magnesium.

In this process the important raw materials are sea water, lime, electric power, and fuel. The approximate requirements per pound of magnesium are: 5 pounds of limestone, 9 kilowatt-hours of electrical energy, and 70,000 Btu of fuel. The optimum location (i.e., the location where these raw materials can be assembled least expensively) has been the Gulf Coast, where sea water, lime (in the form of oyster shells), low-cost natural gas for calcining the limestone and dehydrating the magnesium chloride, and low-cost electric power are all available at a single site. This combination is not available at so low a cost in any other part of the United States. Thus, the advantage of a Gulf Coast location will prevail for some time to come. While electrical energy may be available in Maine at prices competitive with those of the Gulf Coast (6-8 mills per kwh), fuel costs are more than double the Gulf Coast costs (48¢ vs 20¢ per million Btu), which is equivalent to a difference of 2¢ per pound of magnesium. There is, of course, the probability of increased natural-gas costs. If they increase a great deal, other forms of fuel, such as coal or fuel oil, can be used just as easily. Limestone is available in the Thomaston area of Maine and possibly a few miles inland from the proposed Passamaquoddy development, but its delivered cost to a tidewater location would be more than the cost of locally dredged oyster shells on the Gulf Coast.

The capital cost of building an electrolytic magnesium facility in Maine would be somewhat higher than that of a similar facility along the Gulf Coast, because the Maine plant would have to be protected against severe weather. The minimum economic size of a Dow-process electrolytic plant is much larger than that of a Pidgeon-process silicothermic plant (30,000 tons vs 5000-10,000 tons), and capital requirements per unit of capacity are slightly higher (perhaps $800 per annual ton, compared with $600 for the Pidgeon process). Thus, capital investment requirements, even though they may be only a little higher in Maine, are of importance. A 30,000-ton electrolytic plant would employ about 300 people; a 10,000-ton Pidgeon plant, about 150 people.

In the matter of distance from markets, there is little choice between a location in Maine and a location on the Gulf Coast. However, from a Gulf Coast location, barge shipments to the industrial Midwest, the principal consuming area for magnesium, would be less expensive than rail shipments from a Maine location.

In summary, it appears that if additional magnesium facilities based on the electrolytic process are constructed, they will be located on the Gulf Coast, where costs of metal would be over 2¢ per pound less than in Maine. It is possible, of course, that a brine deposit with a high magnesium chloride content might attract an electrolytic plant in the future. However, a brine discovery of this nature seems out of the question in Maine.

2. The Pidgeon Process

In a small plant, the Pidgeon process is more economical than the electrolytic process. Moreover, it produces magnesium of higher purity, which is of particular interest for certain nonstructural uses. (The production of high-purity magnesium by the electrolytic process requires a further purification of the electrolytic metal.) Unless demand increases much more rapidly than we anticipate, new U. S. magnesium capacity may therefore be based on the Pidgeon process.

In this process the magnesium is reduced by thermal means rather than by electrical energy. The principal raw material requirements per pound of magnesium are:

4-1/2 kilowatt-hours (for ferrosilicon)

110,000 Btu of fuel

13 pounds of dolomite

Ferrosilicon, by far the largest single item in the cost of Pidgeon-process magnesium, is produced in electric-arc furnaces from a mixture of iron or steel scrap and quartzite. To produce ferrosilicon economically, quartzite must be available locally along with low-cost electric power.

Alabama Metallurgical's proposed Pidgeon-process plant will be located at Selma, Alabama, where low-cost fuel in the form of natural gas (22¢ per million Btu), relatively low-cost electric power (6 mills per kwh for ferrosilicon and 8 mills for the Pidgeon process), dolomite, and quartzite are all available within a few miles of the plant site. In Maine, dolomite is not available locally; it would have to be shipped in from considerable distances. Sufficient quartzite may be available in the Passamaquoddy area. Plant construction costs would be higher than those in Alabama.

The production of 1 pound of magnesium requires 1.1 pounds of 75% ferrosilicon. The current price for 75% ferrosilicon is 12.5¢ per pound, delivered. With magnesium selling for 36¢ per pound, f.o.b. plant, it can be seen that ferrosilicon costs amount to 40% of the selling price of magnesium. Under such conditions, it is almost imperative that a producer have a captive source of low-cost ferrosilicon.

Freight costs to markets would be somewhat lower from Alabama than from Maine. Thus, if it is assumed that power for the manufacturing of ferrosilicon becomes available in Maine at 4 mills per kilowatt-hour, then the cost of Pidgeon process magnesium would still be more than 2¢ per pound higher than in Alabama. At a Maine power cost of 6 mills per kilowatt-hour, the difference per pound of magnesium would exceed 3¢.

In summary, there appears to be no economic justification for considering the Passamaquoddy area as a likely choice for future magnesium-producing facilities unless electric power can be offered at unrealistically low rates.

IV. FERROALLOYS

A. USES

A ferroalloy, which is a mixture of iron and some other element, is used as a vehicle for introducing the other element into iron or steel. Generally the iron content of ferroalloys is unimportant, and several products (e.g., chromium, manganese, and 98%-grade silicon) commonly referred to as ferroalloys contain little or no iron. Because Maine's deposits of manganese have aroused considerable interest, we have treated the processing of this mineral separately in Section E.

Ferroalloys are manufactured both in blast furnaces and in electric furnaces. In recent years electric-furnace production has been growing at the expense of the blast furnace. Production of alloys in blast furnaces is confined to a very few grades of ferromanganese and ferrosilicon. Since the capital requirements and the technical limitations of producing ferroalloys in blast furnaces make blast-furnace production somewhat less economic, any new construction of ferroalloy plants is likely to utilize electric furnaces.

Each of the many ferroalloys manufactured today has its own particular use or uses. However, ferroalloys of three elements--manganese, silicon, and chromium--account for 93% of total U. S. ferroalloy production. In 1956, U. S. production of ferroalloys totaled 2,640,000 tons, of which 2,460,000 tons consisted of manganese, chromium, and silicon ferroalloys. Of the total output, only about 30% was produced in blast furnaces; the remaining 70% was produced in electric furnaces. In 1956, the best year the industry has ever enjoyed, the total value of ferroalloy production was slightly over $600 million.

Ferroalloys are used primarily by the iron and steel industry to deoxidize steels and to add other elements to steel to impart particular physical properties. Alloys of silicon and manganese are used in the manufacture of all types of steel. Other ferroalloys are used primarily in the manufacture of alloy and stainless steels. Consequently, the demand for silicon and manganese alloys closely parallels the production of carbon steel. Demand for other ferroalloys conforms more closely to the demand for alloy and stainless steels.

Lesser amounts of ferroalloys are used by the foundry industry in the manufacture of iron and steel castings. However, demand in the foundry industry is small, compared with that of the steel industry.

Silicon metal, which is generally classed as a ferroalloy even though it contains little or no iron, is used in quantity by the aluminum industry as a means of deoxidizing and adding silicon to aluminum alloys.

B. PRODUCERS

There are numerous producers of ferroalloys in this country. The industry is dominated by Electro Metallurgical Company, a division of Union Carbide Corporation, which accounts for almost two thirds of the total U. S. production of electric-furnace ferroalloys and manufactures practically every type and grade of alloy. Vanadium Corporation of America is the second-largest producer, accounting for perhaps 20% of the electric-furnace ferroalloy production. The remaining 15-20% of the industry is divided among a number of smaller companies, including Pittsburgh Metallurgical Company, Inc., Ohio Ferro Alloys Corporation, Tennessee Products Corporation, and Chromium Mining and Smelting Corporation. In addition, two of the steel companies--United States Steel Corporation and Bethlehem Steel Corporation--produce ferromanganese in blast furnaces. Since their production is consumed largely within their own companies, they are not important sellers of ferroalloys on the open market.

In spite of the apparent domination of the ferroalloy industry by the two large electric-furnace producers, the industry is highly competitive and producers are very reluctant to release information on production rates or specific alloys and on production costs. Table VIII lists present electric-furnace producers of silicon, manganese, and chromium ferroalloys in this country, their plant locations, and the types of alloys they produce.

Table VIII is by no means an exhaustive list. It excludes many companies that are primarily in other businesses and produce either one or more specialty alloys as a side line. Many of these companies also produce other alloys of less important tonnage. The specialty ferroalloy business does not require large facilities. The alloys are generally produced either in small special furnaces or in the same furnaces used for silicon, manganese, and chromium alloys.

C. SUPPLY AND DEMAND

Over the past few years, demand and supply for ferroalloys have been reasonably in balance. Although the productive capacity of

TABLE VIII

ELECTRIC-FURNACE PRODUCERS OF MANGANESE, CHROMIUM, AND SILICON FERROALLOYS

Company	Location	Types of Alloys
The Anaconda Company	Anaconda, Montana	Manganese
Chromium Mining and Smelting Co., Ltd.	Riverdale, Illinois	Chromium
Electro Metallurgical Company	Alloy, West Virginia	All Alloys
	Portland, Oregon	Manganese and silicon
	Sheffield, Alabama	Manganese and silicon
	Niagara Falls, New York	All Alloys
	Marietta, Ohio	All Alloys
	Ashtabula, Ohio	All Alloys
Hanna Nickel Smelting Company	Riddle, Oregon	Silicon
Interlake Iron Company	Beverly, Ohio	All Alloys
	Jackson, Ohio	Silicon
Keokuk Electro-Metals Company	Keokuk, Iowa	Silicon and chromium
	Wenatchee, Washington	Silicon
Montana Ferroalloys, Inc.	Woodstock, Tennessee	Silicon and chromium
Ohio Ferro-Alloys Company	Brilliant, Ohio	Chromium and silicon
	Philo, Ohio	Silicon and manganese
	Tacoma, Washington	Silicon
Pacific Northwest Alloys, Inc.	Mead, Washington	Silicon and chromium

TABLE VIII (Continued)

Company	Location	Types of Alloys
Pittsburgh Metallurgical Company, Inc.	Calvert City, Kentucky	Manganese, silicon and chromium
	Charleston, South Carolina	Manganese, silicon and chromium
	Niagara Falls, New York	Silicon and chromium
Tennessee Products and Chemical Corporation	Chattanooga, Tennessee	Manganese and chromium
Tenn-Tex Alloy and Chemical Corporation	Rockwood, Tennessee	Ferrosilicon and ferromanganese
	Houston, Texas	Silicon and manganese
Vanadium Corporation of America	Niagara Falls, New York	Manganese, silicon and chromium
	Graham, West Virginia	Silicon and chromium

Source: U. S. Bureau of Mines, Mineral Industry Survey, 1956, and Arthur D. Little, Inc.

domestic plants is not sufficient to meet demand, imports make up the difference. The level of imports is directly dependent upon the demand for ferroalloys: with demand high, imports are high; with demand low, imports are small. Capacity of the ferroalloy industry has been expanded to meet the needs of the steel industry. In fact, since the demand for stainless steels has been greater than that for carbon steels, ferroalloy productive capacity has increased at a somewhat faster rate than that of the steel industry as a whole. Because ferroalloy producers have been willing to expand their plant capacity to keep pace with the steel industry, severe shortages of ferroalloys have not existed. Temporary shortages have been offset by imports within relatively short periods of time.

Because of a continuing trend towards higher alloy and stainless steels, we expect the demand for ferroalloys to continue to increase, at a slightly faster rate than the steel industry as a whole. In the post World War II period, the U. S. steel industry has increased capacity by 50%, or just over 3% per year. Demand for stainless steel has more than doubled in the same period. We do not expect capacity or demand for steel to continue to increase at a similar rate over the next 12-year period.

While we do not expect the industry to continue to grow at the present rate, we expect that growth will be well above that of the steel industry as a whole. Consequently, additional ferroalloy plants will be required in the next few years.

D. LOCATIONAL FACTORS

The domestic ferroalloy industry is centered in New York, Pennsylvania, and Ohio. Important plants are located in West Virginia, South Carolina, Tennessee, and Alabama. It is evident from this pattern of distribution that the basis for plant location is primarily low-cost electric power and proximity to steel producers, the primary consumers of ferroalloys. The second most important consumers are iron and steel foundries, which, by and large, are located in the same areas as the steel producers.

Electric-power requirements for the ferroalloy industry vary widely, depending upon the particular alloy being produced. Minimum power requirements for some of the more common ferroalloys, such as the standard manganese and silicon alloys, may be as low as 4000 kilowatt-hours per ton; for certain of the more special alloys, power requirements exceed 10,000 kilowatt-hours per ton. An alloy plant of about the smallest economic size would have a capacity of perhaps 30,000 tons per year, with power requirements in excess of 20,000 kilovolt amperes. Capital investment requirements would be about $2.5 million. In the over-all manufacture of ferroalloys, power costs amount to 10% of the selling cost of the alloys. Because of this relatively important cost item, most electric-furnace ferroalloy plants are located in areas of low-cost power, as shown in Table VIII.

The primary raw materials for producing manganese, chromium, and silicon alloys are: manganese and chromium ore, silica (most commonly in the form of quartzite), coal, coke, iron and steel scrap, and fluxing materials, such as limestone. Practically all chromium and manganese ores are imported by sea since domestic ores are of a much lower grade. Quartzite is available in this country. Requirements for ore vary depending upon the alloy produced. In manganese and chromium ores 4000-5000 pounds of ore per ton of ferroalloy are used. Requirements for other materials, such as coal, coke, fluxing materials,and scrap, are not too important, for they are generally available.

Since many of the most important raw materials for ferroalloy manufacture are imported by water, a location on the seacoast is desirable. Many of the older ferroalloy plants, however, are located in areas such as Niagara Falls, where low-cost power is available but where deep-water shipment of ores is not available on a year-round basis. Although ore shipments by rail add significantly to the production costs of these plants, the relatively high freight charges on ores moved inland can be partially offset because the plants are located close to markets. Since most ferroalloys are sold on a delivered-price basis, transportation of the product to market is of importance to the producer. Since there are substantial weight losses between raw materials and finished product, locations which minimize shipping costs of raw materials to processing plants are advantageous, provided power costs at such locations are reasonable.

Except for an area in Alabama and a few scattered locations in the western United States, the primary market for ferroalloys is concentrated in a rather narrow belt between Chicago and Philadelphia; thus, producers have tended to build their plants near this belt. The availability of low-cost power generated from coal on the Ohio River, coupled with the availability of barge transportation of raw materials on inland waterways, has influenced a number of companies to locate either on or close to such inland waterways.

A ferroalloy plant located in Maine would have the advantage of reasonably priced electric power and a location on tidewater, where raw materials could be economically assembled. However, the location would be some distance from markets, and unless electric power rates approaching 4 mills per kilowatt-hour were established, it seems unlikely that a ferroalloy plant would locate in Maine.

Maine would be competing primarily with locations on the Gulf Coast, the inland waterway system, and possibly the Great Lakes-St. Lawrence Seaway, where: (1) raw-material costs would be only a little higher than in Maine, (2) power costs would be 4-6 mills, and (3) lower-cost transportation would be available to the principal markets.

E. MANGANESE

The consumption of manganese in the United States is tied very closely to steel production, 95% of the manganese being consumed in iron and steel manufacture. The steel industry has been consuming manganese at a rate of 17 pounds per ton of steel produced. This rate is quite stable, although it has risen slightly over the past 15 years.

We estimate steel-industry requirements for manganese to be 960,000 short tons in 1960 and 1.1 million short tons in 1970, compared with 750,000 short tons in 1956.

The price of foreign high-grade manganese ores has been declining slowly over the past few years. Currently, the price is $1.00-1.10 per long-ton unit of manganese, f.o.b. East Coast ports, duty unpaid, on 48-50% manganese ores. We expect that the price will be stabilized at $1.10-1.20 per long ton unit of manganese.

Approximately 75% of the manganese ore consumed goes into standard grades of ferromanganese produced in both blast furnaces and electric furnaces. This material is nominally 74-76% manganese. All other grades of ferromanganese are made in electric furnaces. Electrolytic manganese is becoming a more important source of manganese for high-alloy and stainless steels and nonferrous alloys.

Manganese ore for consumption in the United States is obtained almost entirely from foreign sources. The U. S. Government has maintained a buying program for domestic ores, but these materials, usually of inferior quality and high price, have been put into the stockpile instead of being converted to ferro- or electrolytic manganese. The Anaconda Company has the only significant domestic operation, at Butte, Montana, where high-carbon ferromanganese and manganese dioxide nodules are produced from domestic ores. Manganese, Inc., has an operation at Henderson, Nevada, producing nodulized concentrates based on ores from the Three Kids district of Nevada. Both of these operations depend upon a physical beneficiation of the raw ore, followed by agglomeration.

Several chemical processes designed to upgrade domestic ore to an economically attractive material suitable for large-scale consumption in the United States have been proposed and studied. The Luete-Dean process, which is an ammonia-leaching technique to solubilize the manganese as the amine complex, has been piloted; and a semiworks installation is in continuous operation at Riverton, Minnesota. It produces high-grade dioxide for special battery applications.

After examining all the proposed processes in considerable detail, we have concluded that the nitric-acid-leaching process offers the least expensive route for the conversion of Maine ores to a high-grade manganese product. The nitric-acid-leaching process will produce a 62.8% manganese concentrate suitable for further processing to ferromanganese and electrolytic manganese.

1. Outlook for Ferromanganese Production Using Maine Ores

So that production costs can be minimized, manganese should be processed as near as possible to the mine site. We have used Presque Isle, Maine, as the point for concentrate production. It is not economic to transport the raw ore to the Passamaquoddy area. The effect of electric-power cost at this site is relatively minor and would amount to about 0.9¢ per long-ton unit of manganese produced for each mill

charge of delivered power. For a 100-ton-per-day concentrate plant, the cost of raw ore delivered to the processing plant would be $2.50 per ton (dry basis). If we assume that electric power will cost 10 mills per kilowatt-hour, a 62.8% manganese concentrate can be produced and delivered to Eastport, Maine, for about $1.50 per long-ton unit of manganese after credit for a fertilizer by-product has been applied. This offers no advantage over foreign ores at present or expected prices.

If we consider a similar plant producing 400 tons per day of the same manganese product and a cost of $2.00 per ton or raw ore delivered to the processing plant, the delivered cost to Eastport becomes $1.46 per long-ton unit of manganese. The lower cost of the ore in this instance would be the result of a much larger-scale mining operation. This cost includes credit for by-product fertilizer consistent with the limitations of the market for such a material. While the cost is somewhat more favorable than that for the smaller plant, Maine ores do not appear to offer any advantage over foreign ores, especially in view of the fact that the price of imported ore is likely to be stabilized at $1.10-1.20 per long-ton unit.

2. Outlook for an Electrolytic Manganese Operation in the Passamaquoddy Area

The production of electrolytic manganese is a rather difficult operation in which a very pure manganese sulfate is electrolyzed to produce platelets of 99.9% manganese. Since direct manufacturing costs incurred in the production of the metal are relatively constant from location to location, except for the ore cost and the power cost, they are the only factors considered here. Ore cost delivered to Eastport, Maine, or to Baltimore, Maryland, has been taken at $1.20 per long-ton unit, including duty. The electrolytic manganese plant, in this case, has been assumed to produce 60 tons per day of metal.

Figure 2 shows the effect of Passamaquoddy power costs on the total direct cost of electrolytic manganese delivered to Pittsburgh, Pennsylvania. We used the following items to develop these costs:

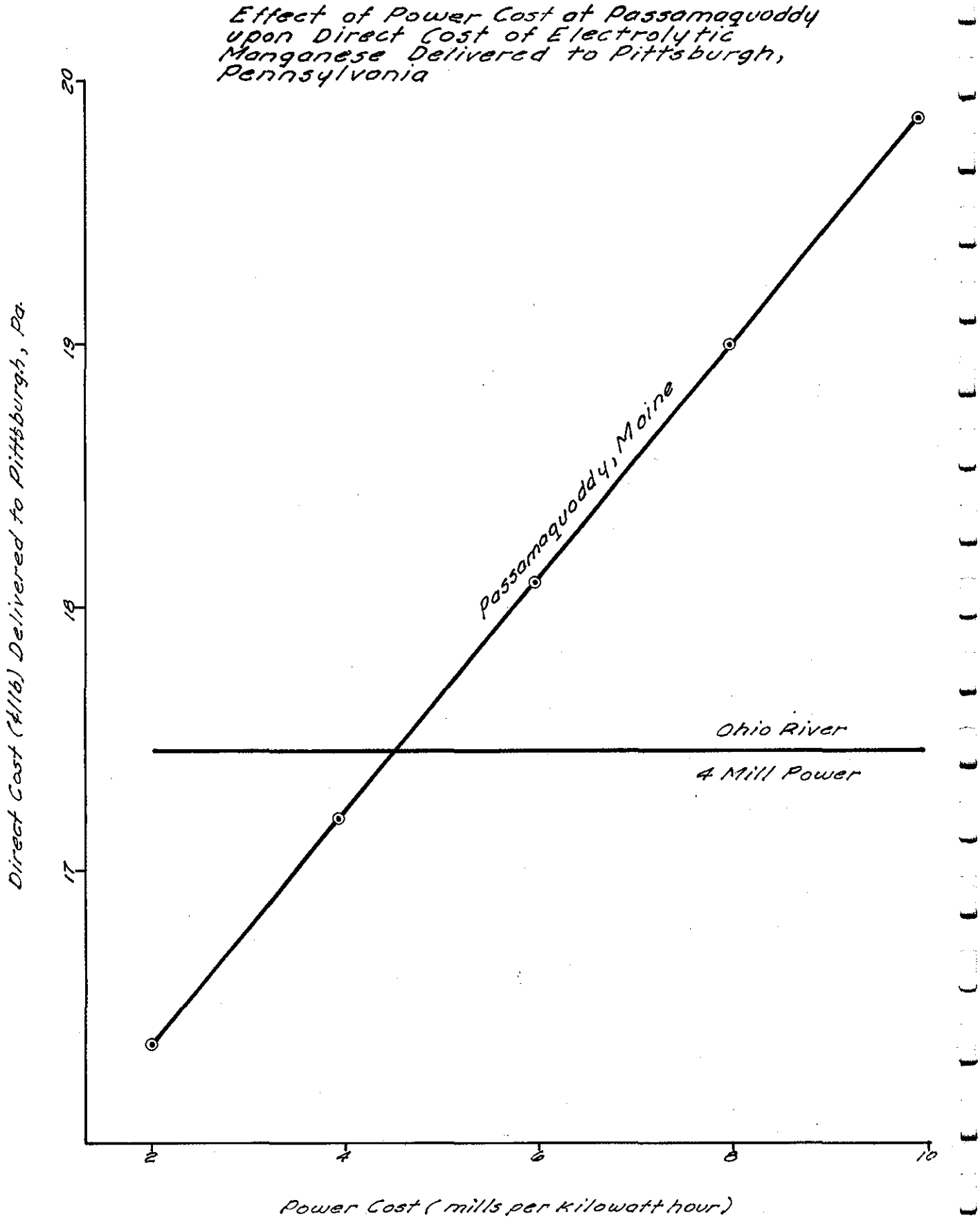
Ore cost to Eastport, Maine	$1.20/long-ton unit of manganese
Ore cost - 90% yield	5.95¢/lb of manganese produced
Manufacturing cost, excluding ore and power	8.28¢/lb of manganese produced
Freight charges for electrolytic manganese to Pittsburgh, Pennsylvania	1.21¢/lb of manganese produced

Costs, developed in a similar manner for an operation based on foreign ores processed in an Ohio River location, are given below for comparison:

Ore cost to Baltimore, Maryland	$1.20/long-ton unit of manganese
Freight for ore shipment to Ohio River location	$0.148/long-ton unit of manganese
Ore cost - 90% yield	6.70¢/lb of manganese produced
Manufacturing cost, excluding ore and power	8.28¢/lb of manganese produced
Power cost at Ohio River location (4 mills per kwh)	1.80¢/lb of manganese produced
Freight charges for electrolytic manganese to Pittsburgh	0.67¢/lb of manganese produced
Total direct cost to Pittsburgh, Pennsylvania	17.45¢/lb of manganese produced

These rough estimates, based on a single pair of representative examples, indicate that power cost at Eastport must be 4 mills per kilowatt-hour or lower in order to warrant an operation in Maine.

FIGURE 2


Effect of Power Cost at Passamaquoddy upon Direct Cost of Electrolytic Manganese Delivered to Pittsburgh, Pennsylvania
Direct Cost (¢/lb) Delivered to Pittsburgh, Pa.
20
19
18
17
Passamaquoddy, Maine
Ohio River
4 Mill Power
2
4
6
8
10
Power Cost (mills per kilowatt hour)

3. Outlook for an Electric-Furnace Ferromanganese Operation in the Passamaquoddy Area

The efficient production of ferromanganese via the electric furnace usually depends upon a source of low-cost power. Most of the existing producers are close to such power. Figure 3 shows how power cost at a Passamaquoddy location affects the direct cost of electric-furnace ferromanganese delivered to Pittsburgh, Pennsylvania. The elements used in the cost computation are given below:

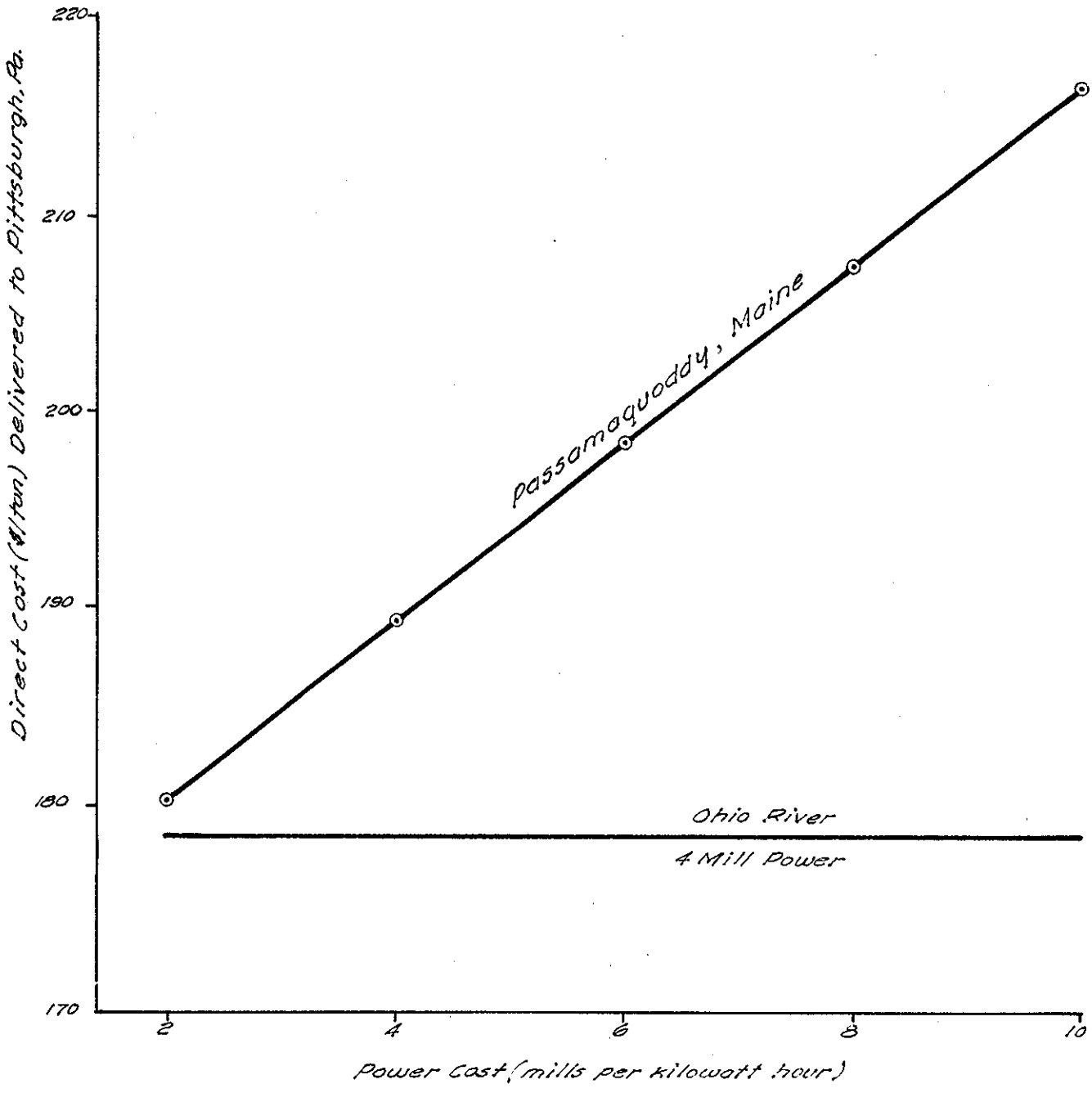
Ore cost to Eastport, Maine	$1.20/long-ton unit of manganese
Ore cost - 85% yield	$103.00/ton of ferromanganese produced
Manufacturing cost, excluding ore and power	$45.00/ton of ferromanganese produced
Freight charges for ferromanganese to Pittsburgh, Pennsylvania	$24.12/ton of ferromanganese produced

Comparative direct costs of ferromanganese delivered to Pittsburgh but produced on the Ohio River are given below for comparison:

Ore cost to Baltimore, Maryland	$1.20/long-ton unit of manganese
Freight for ore shipment to Ohio River location	$0.148/long-ton unit of manganese
Ore cost - 85% yield	$107.50/ton of ferromanganese produced
Manufacturing cost, excluding ore and power	$45.00/ton of ferromanganese produced
Power cost at Ohio River (4 mills per kilowatt-hour)	$18.00/ton of ferromanganese produced
Freight charges for ferromanganese to Pittsburgh, Pennsylvania	$8.27/ton of ferromanganese produced
Total direct costs	$178.77/ton of ferromanganese produced

FIGURE 3

Effect of Power Cost at Passamaquoddy upon Direct Cost of Electric-Furnace Ferromanganese Delivered to Pittsburgh, Pennsylvania



Thus, the operation of an electric-furnace ferromanganese plant does not appear to be competitive unless 2-mill power is available in Maine.

4. Conclusions

1. There appears to be no real opportunity for an advantageous operation using domestic Maine ores and Passamaquoddy power to produce a manganese concentrate. If the delivered price of foreign ores rises to $1.50 per long-ton unit, this operation might be sufficiently profitable to be of interest. Barring a wartime situation, however, the possibility of foreign manganese ore prices rising to that level seems very remote.

2. In view of the fact that there is no advantage in producing a domestic manganese product in Maine, there appears to be no reason for preferring domestic over imported ore to produce ferromanganese or electrolytic manganese.

3. If power could be obtained at 4 mills per kilowatt-hour or less at Passamaquoddy, an electrolytic manganese plant would be competitive with an operation on the Ohio River, where 4-mill power is available.

4. Electric-furnace ferromanganese production based on Passamaquoddy power does not appear to be competitive with a facility in an Ohio River location unless power can be purchased for 2 mills per kilowatt-hour.

V. SILICON CARBIDE

A. SIZE OF INDUSTRY

More than three quarters of the crude silicon carbide used in the United States is imported from Canada; however, all of the Canadian plants are owned by U. S. companies who import about 80% of the Canadian output of the crude material. The distribution of facilities on both sides of the border was brought about by limitations in the available supply of the necessary low-cost power on the U. S. side, and it is made economically feasible by the fact that crude silicon carbide moves into the United States duty-free. Because of the structure of the industry and the form in which statistical data is available, production figures must be shown for the United States and Canada combined. (See Table IX.)

Industry spokesmen estimate that U. S. imports used for abrasives amounted to approximately 50% of the total U. S.-Canadian production, or 48,000 tons, in 1956. Total imports plus U. S. production of the crude material were in the magnitude of 86,000 tons; therefore, some 38,000 tons was used for refractories and metallurgical uses. The resulting distribution pattern is:

	Percentage of Total U. S. Commercial Supply
To abrasives	56
To refractories and metallurgical uses	44

The five North American producers of crude silicon carbide and the locations of their facilities are as follows:

Producer and Plant Locations	Total Number of Plants
Carborundum Co. Niagara Falls, New York Vancouver, Washington Shawinigan Falls, Quebec	3
Electro Refractories & Abrasives Corp. Cap de la Madeleine, Quebec	1

Producer and Plant Locations (Continued)	Total Number of Plants
Exolon Co. Thorold, Ontario	1
General Abrasive Co., Inc. Niagara Falls, Ontario	1
Norton Co. Chippawa, Ontario Cap de la Madeleine, Quebec	2

With one exception, all of these facilities are located in the Niagara area, at low-cost power sources, and reasonably close to principal market centers. The location of the remaining one in the Pacific Northwest was determined by: (1) the availability of low-cost power and (2) the growing West Coast market.

B. EXPECTED GROWTH

Abrasives and cutting tools will continue to be the principal markets for crude silicon carbide. In this use, the material competes principally with aluminum oxide and diamond, and accounts for 20% of the total abrasives market.

Silicon carbide abrasives are comparatively expensive; in recent years, the value of crude silicon carbide has exceeded by one-half that of aluminum oxide. The competitive advantage of silicon carbide, however, is its hardness, which is exceeded only by that of boron carbide and diamond. This quality makes the material suitable for grinding and polishing hard materials of low tensile strength, particularly iron castings, but not excluding copper, brass, aluminum, carbide tools, stone, ceramic products, and leather. Presently, 60% of all silicon carbide abrasives are sold in the form of grinding wheels, but the use of coated abrasives is increasing rapidly.

Normally, sales of silicon carbide tend to fluctuate with steel. Since 1950, however, this correlation has been impaired by developments within the artificial-abrasives industry and, paradoxically, by a recent expansion of the carbide market. Historically, silicon carbide abrasives have been used extensively for grinding high-speed tools; during recent years, however, cemented carbide has been displacing high-speed tools. The result has been a shift from carbide to diamond grinding tools.

TABLE IX

SILICON CARBIDE PRODUCTION AND COMMERCIAL USE

	U. S. - Canadian Capacity (tons)	U. S. - Canadian Production		Estimated* U. S. Commercial Use (tons)
		Tons	% of Capacity	
1950	84, 400	65, 000	77	58, 500
1951	106, 700	100, 500	94	90, 400
1952	111, 200	91, 500	82	82, 400
1953	110, 900	62, 300	56	56, 100
1954	120, 000	67, 000	56	60, 300
1955	118, 800	74, 800	63	67, 300
1956	118, 900	95, 800	81	86, 200
1957	131, 900	124, 700**	95	73, 300***
1965	146, 000	117, 000	80	105, 000
1970	175, 000	140, 000	80	125, 000

* Estimated to be approximately 90% of total U. S. - Canadian production.

** Includes large tonnage for national stockpile.

*** Commercial sales in 1957 are estimated by industry spokesmen to have been 15% below the 1956 level.

Source: U. S. - Canadian Capacity and Production, U. S. Bureau of Mines; 1970 commercial use assumed to parallel increase in steel demand; 1956-1970 forecast by Arthur D. Little, Inc.

Industry spokesmen believe that this situation is now stabilizing; consequently, the previous relationship of silicon carbide to ferrous metals will be re-established. Tending to intensify the relationship with ferrous metals is the fact that in recent years there has also been a shift within the silicon carbide abrasive market; the use of the material for metal working is gaining much more rapidly than for working nonmetallic products. This shift is expected to be intensified rather than diminished in the future.

Balancing the recent developments in this segment of the total market, future sales for silicon carbide abrasives should grow at approximately the same rate anticipated for steel.

Refractory use of silicon carbide is second in importance. In this field, its position is that of a specialty material. Because it is comparatively expensive, its use as a refractory material has been limited to those applications which capitalize on the material's low coefficient of expansion, its very high degree of thermal conductivity, and its chemical and physical stability to temperatures up to 3000F.

In the past, this use of silicon carbide has grown somewhat more rapidly than the ferrous metals industry. Between now and 1970 it should at least parallel the growth of steel.

Other uses of silicon carbide represent a comparatively negligible but growing tonnage. Exploiting its characteristics of hardness, heat resistance, imperviousness to corrosive materials, high thermal conductivity, and wear and abrasion resistance, silicon carbide has been used successfully in a number of new applications, including sand-blast nozzles, rocket nozzles, structural elements in nuclear reactors, heat exchangers, hearths and skid rails in furnaces, and pumps for handling molten aluminum. While these uses of silicon carbide may be expected to grow most rapidly, it is doubtful that in the aggregate they will overtake the two principal uses--abrasives and refractories. Because of the comparatively small tonnage anticipated for these uses, no separate projection is made.

In summary, the total U. S. demand for silicon carbide in 1970 should be at least 125,000 tons. On the assumption that the present ratio of U. S. consumption to total North American production holds through 1970, this forecast implies a production of about 140,000 tons. Since the industry's preferred operating rate is about 80%, production at this rate would call for an annual capacity of 175,000 tons, or the addition of about 43,000 tons of production facilities.

All producers of silicon carbide consume at least a portion of their own output in the production of abrasives and refractories. At least one of the five producers is actively promoting new uses. Because the field is comparatively small and the industry highly competitive, there are no strong inducements for the establishment of new producers.

It may be assumed that a portion of the additional 43,000 tons of annual capacity required by 1970 will be in the form of additions to present plants. Possibly a maximum of three new 10,000-ton plants will be required.

1. Power as a Locational Requirement

Each ton of crude silicon carbide requires about 7500 kilowatt-hours of electric power. Consequently, the capacity now in place has a maximum annual power requirement in the magnitude of 1000 megawatt hours.

In the production of crude silicon carbide, electric power represents 28% of total production cost. The material is produced by thermal reaction of sand and coke in electric furnaces; consequently, the industry has little hope of reducing its unit power requirement. Hence, it will continue to be primarily power-oriented.

2. Locational Requirements Other than Power

Aside from the availability of low-cost power, which is overriding, there are but two important locational considerations: transportation and market. Given its power requirements, the industry would prefer to locate in relation to market rather than to raw materials. The two essential raw materials for silicon carbide comprise a comparatively small element of manufacturing cost. The supply of sand is widely dispersed; the coke required is preferentially waterborne, if it must be transported any distance to the plant site.

C. POSSIBLE INTEREST IN PASSAMAQUODDY

Compared with present centers of production, (including Vancouver, Washington), Eastport is isolated from the major markets for silicon carbide. On the other hand, the project area offers ample supplies of sand and access to waterborne transportation. While Eastport is less favorable than present production centers, the potential availability of sizable blocks of power would make it quite attractive if power were available at no more than 3.5 mills per kilowatt-hour.

VI. ELEMENTAL PHOSPHORUS

Elemental phosphorus, as such, has virtually no market. In 1956, less than 7% of the phosphorus produced was sold without further processing. (See Figure 4.) Phosphorus-reduction facilities are usually operated in conjunction with derivative-chemical plants.

These derivatives may be grouped into two broad categories: chemicals and superphosphate fertilizers. The manufacture of fertilizers, in which the production of phosphorus is a step, involves use of the electro-thermal process. Since this method is definitely less economical than the chemical, or "wet," process, no fertilizer material is made commercially via the electro process. Accordingly, the electro-thermal production of phosphate fertilizers is eliminated as a possible target industry.

Seven major centers are producing phosphate chemicals. Each of these serves a specific market area, and, together, they serve the entire national market economically. Consequently, it is improbable that a derivative-chemicals industry could be developed in connection with the Passamaquoddy project. Accordingly, phosphate chemicals are also eliminated as a target industry.

If specific locational requirements are satisfied, however, an elemental phosphorus plant might be attracted to the project area in 1970. The possibility of this development will be considered in this section.

A. SIZE OF INDUSTRY

Approximately 86% of all U. S. phosphorus production is converted by the producer and marketed as phosphorus pentoxide (P_2O_5). In most instances, the reduction of the element and its subsequent conversion occur as a continuous process.

Estimated production of elemental phosphorus since 1950 was:

	Tons		Tons
1950	114,600	1953	213,000
1951	147,700	1954	266,900
1952	158,300	1955	293,000
		1956	312,200

Source: Facts for Industry, U. S. Dept. of Commerce.

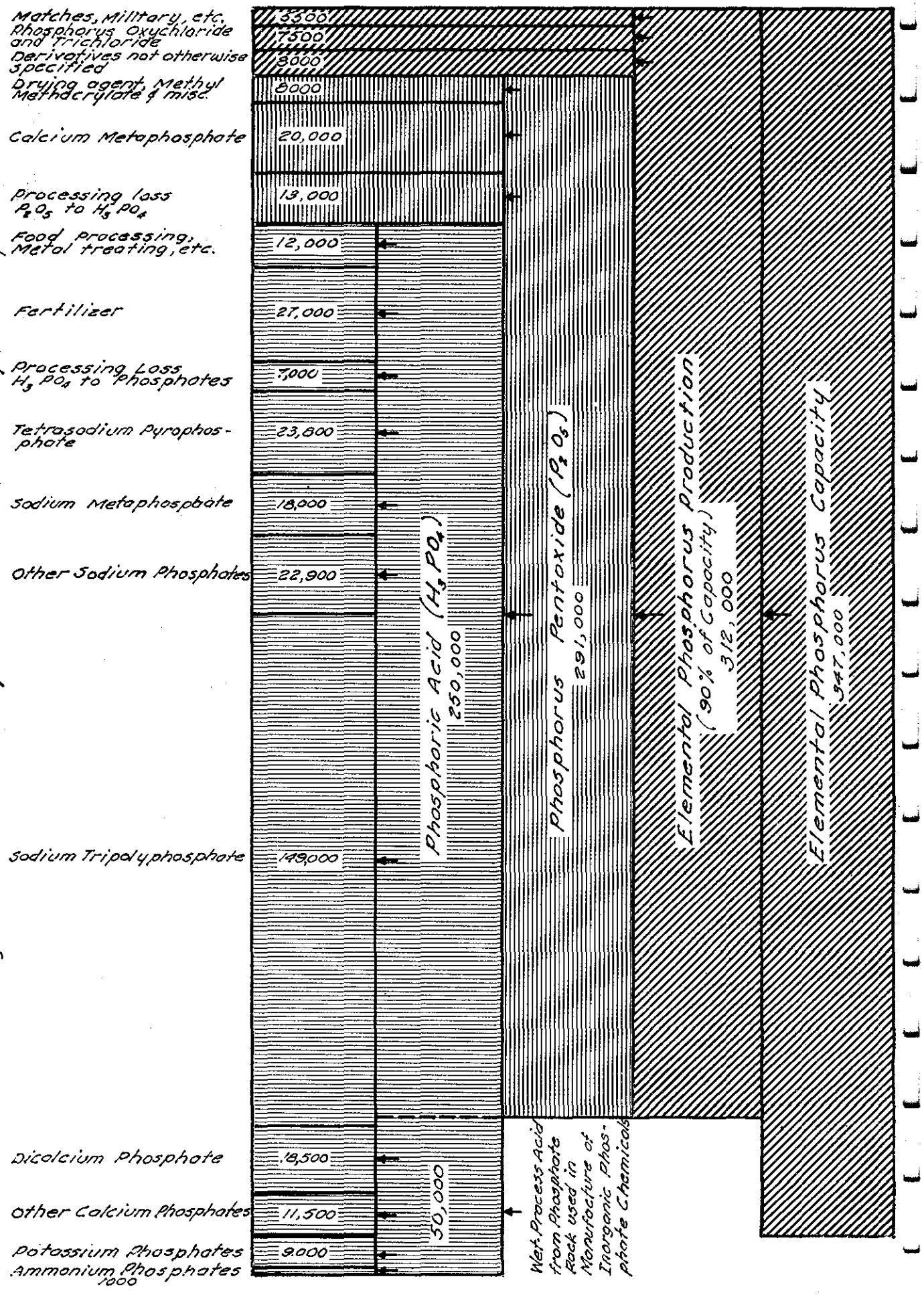


FIGURE 4 , 1956 - Elemental Phosphorus - Distribution by Primary Use

There are presently seven U. S. producers of elemental phosphorus; in addition, one new producer has a plant under construction. Their names, plant locations, existing capacity, and projected capacity additions are shown in Table X and Figure 5.

B. EXPECTED GROWTH TO 1970

Historically, the soap and detergent industry has been by far the largest single consumer of phosphate chemicals. During the study period, several other end uses are expected to grow rapidly, but none of them, either singly or in the aggregate, is expected to displace soap and detergents as the dominant factor in the phosphorus market.

However, anticipated increases in the use of phosphate chemicals for animal feeds, drugs, chemical intermediates, and water treatment, together with a growing export market, will result in a future growth considerably more rapid than that forecast for the population. The anticipated expansion of each of the principal derivative uses of elemental phosphorus is shown in Table XI.

By 1965, the market for phosphorus (equivalent) should be 485,000 tons, a growth of 123,000 tons over the 1956 level; by 1970, the demand should reach 579,000 tons, approximately 217,000 tons over the present level.

On the basis of recent developments, the minimum efficient elemental phosphorus plant would have an annual capacity of about 15,000 tons; several installations now in place, however, far exceed the minimum size. This is particularly true of those plants that have been built to service specific soap and detergent production centers. Since the greatest increase is expected in this end use for phosphorus (equivalent), it is probable that a major proportion of the incremental capacity required will be obtained, first by expansion of existing facilities, and later, by the construction of three or four new plants.

The cost of phosphorus production facilities alone would discourage the entrance of new companies into the field. Added to this deterrent, four large producers out of a total of nine, in effect, control the principal markets for phosphorus (equivalent). Under these circumstances, it is likely that incremental capacity required in future years will be built by existing producers.

TABLE X

U. S. PRODUCERS OF ELEMENTAL PHOSPHORUS*
(Tons)

	1957 Capacity	Projected New Capacity	Total
Monsanto Chemical Company Columbia, Tennessee Soda Springs, Idaho	110,000	---	110,000
Victor Chemical Works Mount Pleasant, Tennessee Tarpon Springs, Florida Silver Bow, Montana	79,000	20,000	99,000
Westvaco Mineral Products, Div. Ford Machinery & Chemical Corp. Pocatello, Idaho	45,500	15,000	60,500
Shea Chemical Corporation Columbia, Tennessee	45,000	---	45,000
Oldbury Electro-Chemical Co. Niagara Falls, New York	8,000	---	8,000
Virginia-Carolina Chemical Co. Charleston, South Carolina Nichols, Florida	14,000	---	14,000
American Agricultural Chemical Co. Pierce, Florida	12,000	---	12,000
Tennessee Valley Authority Muscle Shoals, Alabama	33,500	---	33,500
Potash Company of America Idaho	---	15,000**	15,000
Central Farmers Fertilizer Co. Idaho	---	15,000***	15,000
Total	347,000	65,000	412,000

* Phosphorus or phosphorus equivalent.

** Phosphorus or wet process acid.

*** Construction started. Notwithstanding the unfavorable economics involved, this plant will produce triple superphosphate fertilizer electrochemically. This development, however, does not alter the unfavorable economics of the method, nor does it herald a trend.

Source: Arthur D. Little, Inc.

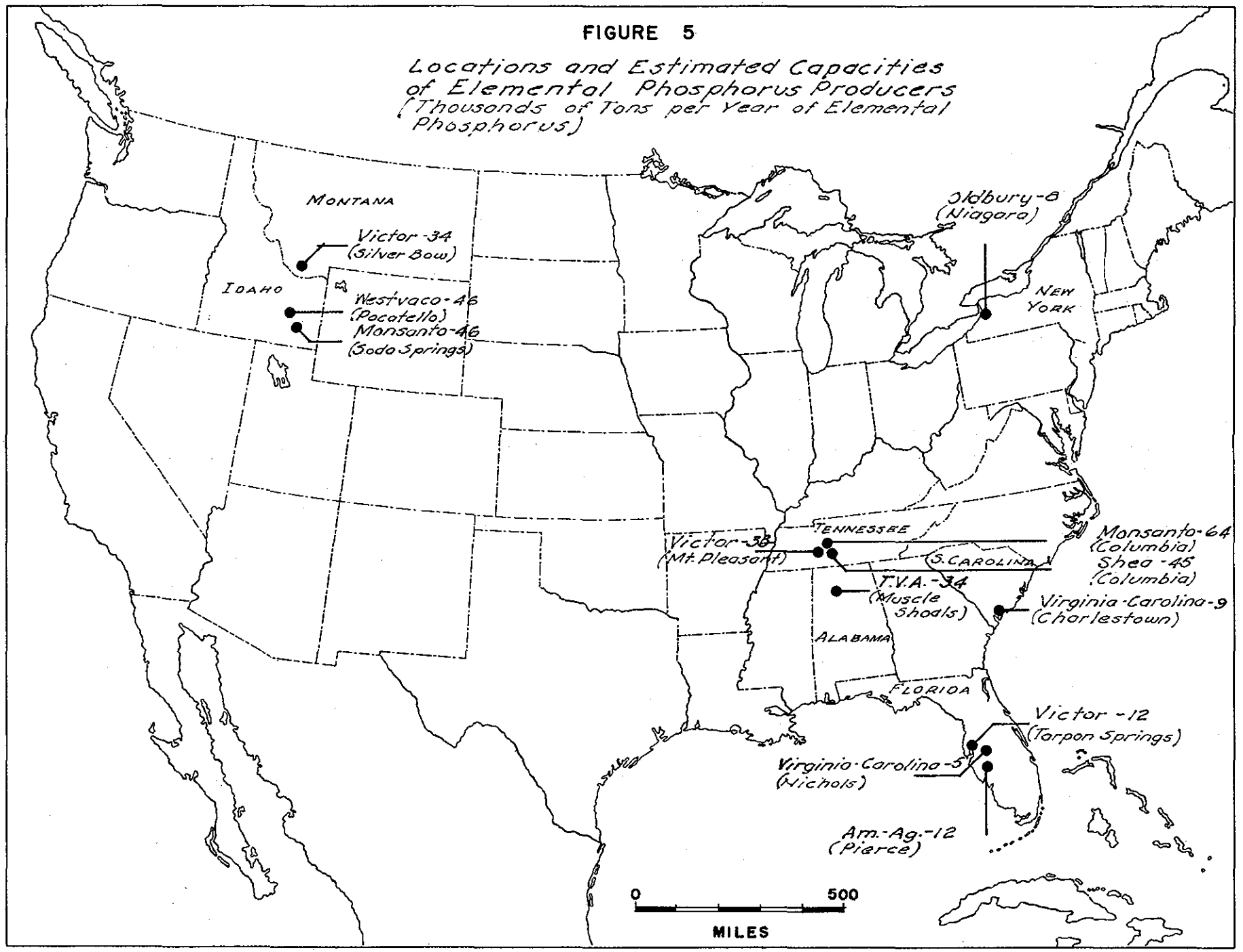


FIGURE 5
Locations and Estimated Capacities of Elemental Phosphorus Producers
(Thousands of Tons per Year of Elemental Phosphorus)
MONTANA
Victor -34
(Silver Bow)
IDAHO
Westvaco -46
(Pocatello)
Monsanto -46
(Soda Springs)
Oldbury -8
(Niagara)
NEW YORK
TENNESSEE
Victor -36
(Mt. Pleasant)
S. CAROLINA
Monsanto -64
(Columbia)
Shea -45
(Columbia)
T.V.A. -34
(Muscle Shoals)
Virginia-Carolina -9
(Charlestown)
ALABAMA
FLORIDA
Victor -12
(Tarpon Springs)
Virginia-Carolina -5
(Nichols)
Am.-Ag.-12
(Pierce)
0
500
MILES

TABLE XI

DISTRIBUTION OF PHOSPHORUS EQUIVALENT IN CHEMICALS, 1956, 1965, AND 1970
(Thousands of Tons)

	1956		1965		1970	
	Tons	% of Total	Tons	% of Total	Tons	% of Total
Soap and detergents	176	48.6	215	44.3	245	42.3
Fertilizers (including TVA use)	49	13.5	70	14.4	85	14.7
Water treatment	24	6.6	33	6.8	39	6.7
Animal feeds	20	5.5	35	7.2	49	8.5
Food processing	11	3.0	15	3.1	17	2.9
Fireworks and pyrotechnics	5	1.5	5	1.0	5	.9
Drugs (including dentifrices)	6	1.6	9	1.9	12	2.1
Metal treatings and surface coatings	2	.3	3	.6	4	.6
Textiles	1	.6	2	.4	5	.9
Intermediates (organic and nonorganic)	15	4.2	28	5.8	37	6.4
Exports	11	3.0	20	4.1	26	4.5
Miscellaneous uses	42	11.6	50	10.3	55	9.5
Total	362	100.0	485	100.0	579	100.0

Source: Arthur D. Little, Inc.

1. Power Requirements

Each ton of elemental phosphorus produced requires approximately 13,200 kilowatt-hours of electricity, but this may vary appreciably with the quality of rock used. The industry's present total theoretical power requirement is almost 4600 megawatt hours per year.

Since the reduction process is a thermal one, few opportunities are in sight for improving the basic power consumption rate.

As a percentage of total manufacturing cost, furnace power looms large--about 28%. Consequently, the producers are vitally interested in power costs. The maximum power cost for an economic operation is 3.75 mills per kilowatt-hour.

2. Locational Requirements Other Than Power

The industry's location pattern has been determined by: availability of power, location of raw materials, and proximity to markets. The large tonnage of phosphate rock required for elemental phosphorus production has virtually dictated that phosphorus-reduction facilities be located as close as possible to rock sources in Tennessee, Florida, Idaho, Montana, and Utah. (See Table X.)

As previously noted, the major market centers for elemental phosphorus (or its primary derivative, phosphoric acid) are the eight established soap and detergent manufacturing centers shown in Figure 6. The likelihood that this pattern will change appreciably during the study period is very slight.

If we assume that power will be available at no more than 3.75 mills per kilowatt-hour, the most formidable obstacles to an elemental phosphorus plant at Passamaquoddy are distance from raw materials and market.

C. POSSIBLE INTEREST IN PASSAMAQUODDY

An elemental phosphorus plant at the project site would have to compete with production plants located close to raw-material sources. The shipment of rock to Eastport would cost about $7.25 per ton, and no other production facility bears a comparable in-bound transportation

charge for its basic supply. Even if we assume the lowest possible power cost for the project site, and the maximum paid by the industry for an alternate facility close to a rock source, direct costs would be almost 50% greater for Eastport.

Consideration of outbound transportation costs intensifies the disadvantage of an Eastport location, since shipments of phosphorus or phosphorus pentoxide would have to be equalized with those of major producers at distant market centers.

In consequence, the possibility of an elemental phosphorus plant at the Passamaquoddy site is ruled out by locational considerations other than power.

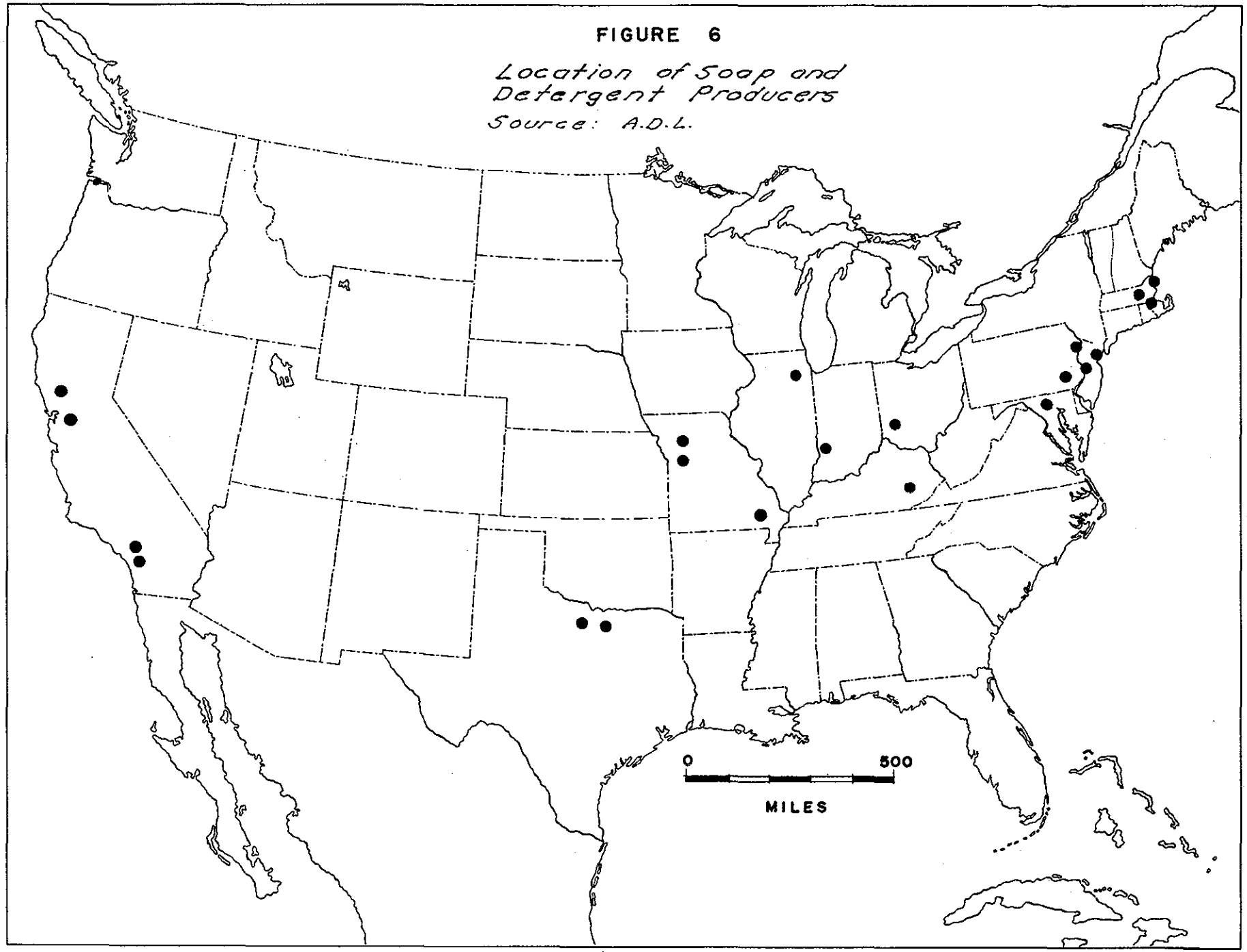


FIGURE 6
Location of Soap and Detergent Producers
Source: A.D.L.
0
500
MILES

VII. BASE METALS

As noted in Part One of this report, there has been considerable exploration activity for base metals in Maine in the past few years. Similar activity has been going on in New Brunswick, where substantial deposits of base-metal ores have been found. One large mine was opened in New Brunswick, but it has recently been shut down, reportedly because of depressed base-metal prices. The New Brunswick ores contain lead, zinc, copper, and precious metals. Indications are that if economic base-metal deposits are located in Maine, they will contain the same metals. If an economic base-metal deposit is found in Maine, there are several possibilities for processing ores from such a deposit.

Milling and concentrating of the ores into a form suitable for smelting or refining would almost certainly be carried out either at or close to the mine site. Indications from the geology of the area are that if an economic deposit is found, it would probably support, at most, a milling operation handling 500 tons of ore per day. It seems even more likely that the deposits would only support a mill designed to handle 200-300 tons per day. Electric-power requirements for a mine and mill operation would be rather modest, averaging 20-25 kilowatt-hours per ton of ore. Thus, a 200 ton-per-day mill would require a capacity of 200 kilowatts, and a 500 ton-per-day mill, 500 kilowatts. These power requirements are small in terms of the proposed Passamaquoddy development.

Further processing beyond the stage of concentrates can either be done in Maine or in smelters and refineries located elsewhere. Several base-metal smelters and refineries are on or near the coast of the Middle Atlantic States. A smelter and/or refinery seems an unlikely prospect for Maine unless the ore deposits exceed present expectations. Smelters and refineries are uneconomic unless several hundred tons per day of concentrates are available for processing.

It might be possible, of course, to build a base-metal smelter in Maine that would process the output of domestic mines combined with imported ores. At the present time, however, the smelting and refining capacity for copper, lead, and zinc is adequate to take care of U. S. base-metal requirements. Although increases in capacity will not be needed for several years, this situation will probably have changed by 1970. Even then, it is not likely that smelters and refineries would be located in Maine merely because of an adequate supply of low-cost power at Passamaquoddy.

In lead smelting, for instance, lead oxide is reduced by solid carbon, usually in the form of coke. Such a reduction is commonly carried out in a blast furnace. High fuel costs in Maine make a lead-smelting operation there highly unlikely. Furthermore, electric-power requirements in conventional lead smelters are very small.

Zinc is produced from zinc oxide concentrates, either electrolytically or in retorts. Retorts use solid fuel, usually coke, as a reductant. Fuel costs in Maine are too high to permit consideration of retort smelting of zinc. Zinc is also produced by electrolysis. In this process, zinc oxide is dissolved in sulfuric acid, the solution electrolyzed, and metallic zinc produced. Electric-power requirements in this process are about 1.7 kilowatt-hours per pound. With power costs of 6 mills per kilowatt-hour, the total cost of electric power would be less than 10% of the cost of the manufacture of zinc. Even in the electrolytic process, fuel requirements are important. With a fuel cost of 48¢ per million Btu, fuel costs would amount to about 25% of the manufacturing cost. The high cost of fuel is therefore a sufficient reason to exclude Maine as a likely location for the electrolytic production of zinc.

Of all the base metals, copper is the most logical candidate for smelting and refining in Maine. In the smelting and refining of copper, fuel and electric-power costs are relatively unimportant. If the newer flash-smelting techniques are used, fuel requirements are only about 6 million Btu's per ton. Electric-power requirements for smelting and refining are only about 500 kilowatt-hours per ton. Thus, neither fuel nor power is a governing factor in a copper smelter or an electrolytic copper refinery.

In summary, as far as lead and zinc are concerned, smelting and refining in Maine hold little promise; the prospects for copper, however, may be promising, for neither electric power nor fuel costs are of significant importance. Moreover, it seems doubtful that smelting and refining facilities for base metals would locate in Maine unless very large economic deposits of such metals are found in or close to the state. The output of any but a very large mine would be processed at existing smelters and refineries.

VIII. HYDROGEN PEROXIDE

We have considered the production of hydrogen peroxide as a target industry, but dismissed it as a possibility. Recent technological developments have made the electrolytic-production method uneconomical; in consequence, all new plants recently built or contemplated utilize nonelectrolytic production processes. Moreover, several electrolytic plants now in operation are scheduled for conversion to nonelectrolytic methods.

IX. CHEMICAL PROCESSES

We have briefly reviewed a large number of chemical processes in which the consumption of electric power is important either because of high energy input per ton of product or because of large over-all power requirements due to volume of output. Table XII summarizes, for the estimated power requirement per ton of product, the cost of power as a percentage of total costs, 1957 production, projected 1970 production, and gross additional power needs at the end of the projection period for the eight most important products of this type.

We have concluded from our survey that several of the chemicals listed in Table XII might be located advantageously in the Passamaquoddy area if large blocks of cheap power are available. We look upon 3.5 mills per kilowatt-hour as cheap power and would tend to exclude Passamaquoddy from consideration if the power cost there were to approach 6 mills per kilowatt-hour. At the latter rate, large blocks of power would be available in areas that are closer to markets or to raw-material sources than southeastern Maine. Besides, most of these chemical processes require a small but highly skilled labor force, which would either have to be imported to the Passamaquoddy area or, if recruited locally, would have to be trained.

The outlook for locating each of several chemical process plants in the vicinity of Passamaquoddy is discussed in the following paragraphs.

A. LITHIUM METAL

This metal is only of modest importance except in the atomic-energy program. The rate of growth anticipated for the next 15 years is high, but total volume requirements are not spectacular. Lithium metal is being considered here because of the very substantial power requirements in the production process. The raw material, which generally takes the form of spodumene concentrates, originates in Quebec, Manitoba, North Dakota, and North Carolina. Some lithium concentrates are also imported from Africa. The markets are located primarily in the North- and South-Central states and in New York state. The preconditions for locating a processing plant in the Passamaquoddy area would be:

a) The availability of power at a considerably more advantageous rate than that in the market areas; and

b) Continued U. S. reliance upon African concentrates delivered alongside the plant by ocean carrier.

Since the metal has a high value per unit weight (about $11 per pound at current rates), the plant's distance from markets would not be a major drawback if power rates are favorable.

B. HIGH-ENERGY FUELS

Boron-based high-energy fuels are under rapid development. Their success or failure will not be known for another two years or so. If they are successfully adapted for use in piloted air-breathing aircraft, substantial quantities may be required by the armed services. Our estimates for high-energy fuels must be accepted as speculative in view of the security classification which surrounds the development.

In general, a high-energy fuel is made by reaction of a metal hydride with a boron halide. The high power consumption per ton of product is due to the electrolysis of lithium or sodium metal, the production of chlorine (all of which could be recycled), and the need for considerable auxiliary refrigeration equipment.

On the assumption that the development program is a success and will expand through 1970, Passamaquoddy might well emerge as an attractive location for a high-energy-fuel facility. Of the raw materials, borax is the most important, followed by certain hydrocarbons and small quantities of salt or lithium concentrates which are needed to make up for the loss in recycling. Borax is produced in southern California. With deep-water docking facilities at or near Passamaquoddy, the shipment of borax by water, via the Panama Canal, might be as cheap as rail shipment to the Midwest. The markets for high-energy fuels are exclusively military; it may be assumed, therefore, that they will be spread fairly widely over the continent, with some in New England and eastern Canada. Because of the toxicity of the product and the emphasis upon dispersal of critical defense facilities, the remoteness of a Passamaquoddy location might be considered a locational advantage for the production of high-energy fuels.

TABLE XII

ESTIMATED POWER REQUIREMENTS OF IMPORTANT CHEMICAL PROCESSES, 1957-1970

Chemical	Power Requirements[1] (Kwh/ton)	Power as % of Total Cost[1, 2]	Estimated 1957 Production (Thousands of Tons)	Estimated 1970 Production (Thousands of Tons)	Gross Additional Power Required by 1970 (Millions of kwh/yr)
Lithium Metal	56,000	5	less than 0.1	60	3,360,000
High-Energy Fuel[3]	46,000	1-2	1	600	27,500,000
Sodium Metal	8,000	48	133	250	936,000
Fluorine	5,800	40	0.5	10	55,000
Chlorates	5,200	12	59	130	369,000
Perchlorates (from chlorates)	3,200	7	1.7	12	32,000
Chlorine	3,000	25	3,917	9,000	15,250,000
Calcium Carbide	2,900	55	1,016	1,200	534,000
					48,036,000

Notes:
1. Assuming total power consumption and cost burden on products, credit for co-products taken.
2. Assuming 3.5 mills/kwh power cost.
3. Fully integrated plant using BCl_3 and LiH route. Boron content in fuel equals 40% B.

Source: Arthur D. Little, Inc., estimates.

C. SODIUM METAL

Except in conjunction with a high-energy-fuel plant, sodium metal is not likely to be produced at Passamaquoddy. Salt deposits are not readily available in Maine, although it is conceivable that Carribean solar salt might be shipped in by boat. However, this would probably be a high-cost operation. The current purchasers of sodium metal are primarily the producers of tetraethyl lead; they are located on the Gulf Coast, the West Coast, and in the Central states.

D. CHLORINE AND CAUSTIC SODA

There is no large market for these chemicals in the northeastern part of the United States. The cost of shipping liquefied chlorine restricts plant location to a relatively short distance from market areas. It is therefore unlikely that such a plant would be built in the Passamaquoddy area unless it is needed in conjunction with a high-energy-fuel plant.

E. FLUORINE

Fluorine is expected to show modest growth during the next decade. Its principal new application is as an oxidizer in missiles. While the distance to markets would be a less important factor than in industrial chemicals, Passamaquoddy seems to offer no real advantage because raw materials are not locally available.

F. CHLORATES AND PERCHLORATES

These chemicals are made by the electrolysis of salt. The main markets for chlorates are the Pacific Northwest, the North Central states, and the Southeastern states. Perchlorates are primarily used as solid-propellant oxidizers. Passamaquoddy would be a poor location for both of these chemicals from the point of view of markets and raw materials.

G. CALCIUM CARBIDE

Calcium carbide is made in electric furnaces from limestone and coke. It is used in the production of acetylene, the major portion of which is used in chemical synthesis. Main centers of acetylene consumption are along the Gulf Coast, the shores of Lake Erie, and the Ohio Valley. The latter two areas are favorably situated with respect to coking coal deposits.

X. IRON AND STEEL

After considering the production of iron and steel as a target industry, we dismissed it on grounds other than electric-power requirements and costs. Briefly, two factors make an iron and/or steel project uneconomical: the inaccessibility of the site to economic raw-material sources and the comparative distance from major market areas.

In considering the production of iron and/or steel in Maine, we briefly evaluated four alternatives: (1) an integrated steel mill; (2) an iron-reduction facility; (3) a small electric-furnace steel plant; and (4) a specialty-alloy and stainless-steel plant.

A. AN INTEGRATED STEEL MILL

To be economical, a primary iron- and steel-making facility must be very large. The minimum economic size is probably in excess of 1 million tons of annual capacity. Plant location is determined primarily by the delivered cost of primary raw materials at the plant site and the distance from major market areas. The typical integrated steel mill produces hot metal in blast furnaces. The metal is mixed with steel scrap and refined into steel, which is subsequently converted by rolling various semifinished forms. The approximate raw-material requirements per ton of steel for an integrated mill are: iron ore, 1-1/4 tons; coal, 1 ton; steel scrap, 1/2 ton; and limestone, 1/3 ton.

Since the average electric-power requirements for an integrated mill amount to only 250 kilowatt-hours per ton of steel, they represent only a minor element of cost.

Coal costs in Maine are substantially higher than those in other present or potential steel-making centers in the Midwest and Middle Atlantic states. Because scrap is not available in sufficient quantity, it would have to be transported over considerable distances to a Maine facility; thus, it would be relatively expensive. Limestone could be made available at prices comparable to those prevailing in other steel-making areas. Imported ores, which would have to be used in any major iron-reduction facility in Maine, would not be significantly less expensive than the same or similar ores at East Coast ports, such as Philadelphia and Baltimore, which are already major steel-making centers.

Maine is at a locational disadvantage with respect to markets. The New England market is not large enough to support an integrated facility. Freight costs to major marketing areas of the Middle Atlantic states and the Midwest would be prohibitive, compared with those from mills located in these areas.

B. AN IRON-REDUCTION FACILITY

The conventional blast-furnace production of iron would not be economical because of the small size of the market. While it is expensive to bring pig iron into the area, the demand for iron is not large enough to support a conventional blast furnace. A single, small blast furnace operating in the Boston area is adequate to supply practically all of New England's iron needs.

Pig iron can be produced in an electric blast furnace, which inherently has a much smaller capacity than the conventional coke blast furnace. However, even the electric furnace requires a large quantity of coke (about 900 pounds per ton of iron, compared with 1800 pounds per ton in the coke blast furnace); this would militate against a Maine location. The minimum economic size of an electric blast furnace is about 100 tons per day, which is considerably in excess of local requirements.

Other iron-reduction processes have been and are being developed for producing a feed stock for steel-making or foundry operations, but all of these require low-cost fuel. Fuel costs in Maine are too high to permit economic reduction of iron ore.

C. A SMALL ELECTRIC-FURNACE STEEL FACILITY

Many areas have small nonintegrated steel facilities based on the electric-furnace melting of scrap to produce steel for local consumption. Such a facility was put into operation in Bridgeport, Connecticut, two or three years ago. This operation was designed specifically to serve the New England market. It failed because the local market was not adequate to support the additional facilities, and scrap prices were high. East Coast steel mills must compete with Western Europe for U. S. -generated scrap; consequently, scrap prices are relatively high on the East Coast. A scrap-melting operation in Maine would have to serve markets outside of New England. The relative distance from these markets, coupled with the lack and high cost of scrap, would make it extremely unlikely that such a mill could be successful.

D. A SPECIALTY-ALLOY AND STAINLESS-STEEL FACILITY

A specialty steel mill has the same physical equipment as the small mill described above. It melts scrap in electric furnaces to produce high-quality, high-priced specialty steels. Any such mill must sell its product in a national market. Even the Bridgeport facility, which now produces alloy and stainless steels and is located in the heart of the New England market, must sell its products on a national basis. Maine is not a preferred location for a specialty steel mill catering to national markets.

XI. RAYON

We considered the rayon industry as a possible choice for a Maine plant location because of the potential availability of raw material in the form of dissolving pulp rather than because of the proximity of abundant low-cost power. It is thus one of the "target" industries that is not primarily power-oriented.

The rayon industry, which for the purpose of this study includes the manufacturers of both acetate rayon and viscose rayon, had a 1957 output of about 1140 million pounds of filament and staple fiber. Projected domestic requirements for viscose and acetate rayon show an increase to an annual total of 1650 million pounds by 1970. (See Table XIII.) The table also shows how unevenly the various sectors of the industry are expected to grow during the next decade. Thus, the expected rise in demand for rayon staple accounts for virtually the entire increase in domestic rayon requirements between 1957 and 1970.

Table XIV shows the geographical distribution and current capacity of the industry's 27 plants. A comparison of present capacity and projected requirements indicates the imbalance that may be expected to occur in the various types of viscose rayon produced.

While the present capacity for the production of high-tenacity rayon filament is approximately 435 million pounds (Table XIV), the consumption of this filament is projected to be only 250 million pounds in 1970 (Table XIII). This decrease in fiber requirement will be caused by rayon's losing the major part of the tire-cord market to nylon filament. Any foreseeable increase in other applications will not be sufficient to offset this loss.

Viscose rayon textile filament was being consumed at an annual rate of better than 300 million pounds in the early 1950's.

Since that time, demand for the fiber has dropped off, largely because crepe fabrics in women's apparel were being replaced by other fabrics that do not use rayon. We do not anticipate a major comeback of crepe fabrics because of the seemingly permanent change in dressing habits brought on by the development of the newer synthetic fibers. Some growth in the use of this fiber is anticipated, however, as the over-all consumption of apparel increases. Rayon filament is expected to remain one of the cheapest and esthetically most desirable filament fibers.

TABLE XIII

DOMESTIC RAYON REQUIREMENTS IN 1945 AND 1957, WITH PROJECTION TO 1970

	1945	1957	1970
		(Million Pounds)	
Viscose Rayon	568	863	1,300
High-tenacity filament	202	341	250
Textile filament	237	151	200
Staple	129	371	850
Acetate Rayon	214	262	350
Filament	175	208	300
Staple	39	54	50

Source: Arthur D. Little, Inc.

TABLE XIV

PRODUCERS OF RAYON AND ACETATE WITH PLANT LOCATION AND ESTIMATED CAPACITY IN 1957

(Millions of Pounds)

		Viscose Rayon			Acetate		
		Filament		Staple	Filament	Staple	Total
		High Tenacity	Textile				
American Viscose	Front Royal, Va.	x		x			
	Lewistown, Pa.	x	x				
	Parkersburg, W. Va.		x	x			
	Roanoke, Va.		x				
	Nitro, W. Va.			x			
	Meadville, Pa.				x		
		85	100	290	50		525
Celanese	Rome, Ga.		x	x	x		
	Rock Hill, S. C.				x	x	
	Cumberland, Md.				x		
	Narrows, Va.				x	x	
			20	12	170	110	312
Du Pont	Richmond, Va.	x	x				
	Old Hickory, Tenn.		x				
	Waynesboro, Va.				x		
		90	35		30		155
American Enka	Enka, N. C.	x	x				
	Lowland, Tenn.	x	x	x			
		88	28	60			176

TABLE XIV (Continued)

		Viscose Rayon			Acetate		
		Filament		Staple	Filament	Staple	Total
		High Tenacity	Textile				
Industrial Rayon	Painesville, O.	x	x	x			
	Cleveland, O.	x	x				
	Covington, Va.		x				
		90	30				120
Beaunit Mills	Childersburg, Ala.	x		x			
	Elizabethton, Tenn.	x	x				
	Utica, N. Y.		x				
		82	40	12			134
Courtaulds, Ltd.	Le Moyne, Ala.			x			
				150			150
Tennessee Eastman	Kingsport, Tenn.				x	x	
					50	25	75
Mohasco Industries	New Bedford, Mass.		x				
	New Castle, Del.			x			
			6	21			27
Bigelow-Sanford	Rocky Hill, Conn.			x			
				25			25
Fair Haven	Fairhaven, Vt.		x				
			1				1
Total	Plants	9	15	9	7	3	8
	Capacity	435	260	570	300	135	1,700

Source: Arthur D. Little, Inc.

A. VISCOSE RAYON STAPLE

Staple rayon, unlike filament rayon, does not have adequate installed capacity to fulfill the projected demand for rayon staple by 1970. Rayon staple is frequently used in fabrics in place of cotton, principally because of its lower price. Although its growth has been dramatic, it is still somewhat retarded by the physical limitations of the fiber. Recent developments indicate, however, that these limitations are being overcome and that the 4 billion pounds of cotton consumed annually in this country will face increasing competition from rayon staple.

Present capacity for the production of viscose rayon staple is 570 million pounds per year. Additional capacity of about 250 million pounds would therefore be required to meet projected 1970 needs. It is probable that most, if not all, of this new capacity will be installed by the existing major producers--American Viscose, American Enka, and Courtaulds, Ltd. Recent expansion of rayon-staple-producing capacity has taken place in increments of approximately 50 million pounds per year. Four or five new plants of this size would be required to fulfill the 1970 domestic demand for staple.

Both acetate filament and acetate staple are currently being produced substantially under capacity. Although some recovery from present levels is projected for acetate filament, we do not anticipate any need for additional capacity to produce this fiber during the projection period.

Thus, viscose rayon staple appears to be the only product for which important additions in productive capacity can be anticipated. We shall therefore limit ourselves to the locational considerations for this one product.

1. Power Requirements

The power requirements for staple rayon constitute 2.6% of all direct costs of production. This percentage was computed on the basis of 7 mills/kwh power and a consumption of 3.6 kwh per pound of staple rayon produced.

2. Labor

The cost of labor is a much more important consideration in the location of a rayon plant. In the manufacture of staple rayon, labor costs amount to 29% of all manufacturing costs exclusive of depreciation.

(The labor cost represents 55% of manufacturing costs in the case of filament rayon.)

3. Linkages

All but two of the industry's plants are located in the southeastern United States. (See Table XIV.) Raw material and market proximity are responsible for this geographical concentration. The dissolving pulp used in the manufacture of rayon can be supplied by the South's expanding sulfate pulp mills. In return, sodium sulfate, a by-product of rayon production, can be sold to the pulp mills as a raw material in the pulping process. The rayon produced in these plants is within short shipping distance of the southern textile mills, which are the principal customers of the rayon industry.

4. Water Requirements

Rayon mills consume a great deal of water. Each pound of staple rayon produced requires almost 360 pounds of filtered water and 110 pounds of soft water. These water needs could presumably be met in most Maine locations.

B. OUTLOOK FOR PASSAMAQUODDY

To compete with plants in the Southeast, a viscose rayon staple plant located in southeastern Maine would have to:

1. Sell its product predominantly in New England, a market that is more likely to contract than to expand, particularly in its nonwoolen sector.

2. Recruit labor at rates competitive with those of the Southeast; this requirement could probably be met in the depressed counties of southeastern Maine.

3. Purchase all of its raw materials (pulp, caustic soda, and sulfuric acid) under arrangements as favorable as those worked out between Southern rayon and pulp manufacturers. At present, the only producer of dissolving pulp in the Northeast is a sulfite plant at Berlin, N. H. The sulfite process, which is also used in all of the

existing Canadian dissolving-pulp plants, does not lend itself to the economical interchange of raw materials between the rayon and the pulp industry that is being so successfully practiced in the South, where the sulfate process is used for pulping local pine.

PART THREE

IMPACT OF THE PASSAMAQUODDY DEVELOPMENT ON THE ECONOMY OF MAINE

I. INTRODUCTION

For the purposes of this study, it has been assumed[1] that the construction of the Passamaquoddy power project will begin on January 1, 1964, and that the plant will go into operation in 1970. It is therefore necessary to project the economy of Maine to 1970 so that the impact of the project may be evaluated against the circumstances of the time as our studies have indicated that they may be. Previous sections of this report contain a detailed survey of the various sections of Maine's economy, and the trends revealed are used as the basis for an assessment of the state's economic prospects.

For national economic units, it is possible to make Gross National Product estimates and projections that can claim a certain amount of probability; for subnational regions, such calculations are particularly hazardous and involve serious conceptual and practical difficulties. We have therefore assessed Maine's economic future in terms of personal income, which on the basis of the trends revealed in Parts One and Two, we assume will grow at the rate of 1% per annum.

1. From discussions with the Corps of Engineers, Boston.

II. THE MAINE ECONOMY IN 1964 AND 1970

The future growth of the Maine economy will, in our opinion, lag markedly behind that of the United States as a whole. This will result in a substantially lower rate of population growth for Maine (due to out-migration) than that projected for the nation. We consider that the following estimates reflect the economic conditions that will exist in Maine up to 1970.

	Population	Labor Force**
1955	920,000*	344,000
1960	945,000	353,430
1965	970,000	362,780
1970	1,008,000	377,000

* Intercensal estimate (Bureau of the Census).
** 37.4% of the population is assumed to constitute the labor force.

On the assumption that the labor force will remain a constant proportion of population, 33,000 additional workers will be available for employment in 1970. It is, of course, impossible to predict the employment distribution of these additional workers, but their ultimate absorption into the labor force is compatible with our assessment of Maine's economic future.

III. EMPLOYMENT TRENDS IN THE MAINE ECONOMY

Employment in manufacturing industry amounted to 34.2% of total employment in Maine in 1950. This proportion is higher than that of manufacturing to total employment in the United States and more than twice that of the state's next largest industry group (wholesale and retail trade). Further increases in employment, however, are unlikely, and some decline may take place. The important textile industry will undoubtedly decline further, and although the pulp and paper industry will probably increase in value of output, improvements in technique may lead to a much slower rate of increase in employment. Employment in the leather trades may increase slightly, but in our opinion, important advances are not likely. Smaller segments of the manufacturing economy--particularly food processing--may expand, but by 1964, manufacturing employment will probably not exceed present levels.

Little relief can be expected from the extractive sector of the economy unless important mineral discoveries are made. Agricultural technique is advancing rapidly in Maine, and a reduction in employment (notably the decline of subsistence farming) may well accompany the anticipated future increases in output. The fishing industry will at best hold its own and improvements in technique may reduce employment in this industry still further.

In the absence of new and, at present, unforeseeable employment opportunities, contract construction and the various service trades appear to offer the most attractive opportunities for employment in the 1960's. In both cases, further labor-saving devices may be slow to appear, and a substantial number of new job opportunities may become available.

Because of military construction, contract construction as a source of employment and income has increased somewhat since 1948. Further advance and slow addition to the 1956 level of employment (13,100), however, can be expected as population and living standards increase and urban settlement proceeds.

Substantial increases in employment in the service trades have been registered in recent years, and this trend is also likely to continue. It should be borne in mind, however, that the service trades, with the exception of those catering to tourists, will probably not continue to increase in the face of an actual decline in primary and secondary employment.

The employment opportunities that may be provided by federal, state, and local government agencies cannot, of course, be estimated. Nevertheless, it seems probable that they will remain substantial. In 1956, all government activity provided 44,000 jobs in Maine.

IV. IMPACT OF THE CONSTRUCTION AND OPERATION OF THE PASSAMAQUODDY POWER PROJECT

To assess the impact of the Passamaquoddy power project on the state of Maine, it is necessary to project the state's economy to 1970. To do this, we have applied the U. S. Department of Commerce calculations of personal income in Maine to our population projections on the basis of a 1% annual increase in per-capita income in terms of constant 1955 dollars. The results are of limited value in themselves, but they provide an estimate against which it is possible to evaluate the economic significance of the proposed power plant in terms of its effect on the economy of Maine.

Total Personal Income, State of Maine
(Thousands of 1955 Dollars)

	Population	Per-Capita Income	Total Income
1955	920,000	1.57	1,444,400
1960	945,000	1.65	1,559,250
1965	970,000	1.734	1,681,980
1970	1,008,000	1.823	1,837,584

It is understood that the total investment required for construction of the proposed project will amount to approximately $400 million. Of this sum, approximately $200 million will be required for the purchase of electrical and other equipment from outside the state. On the assumption that 50% of the remaining expenditures will take place in Canada, total investment outlays in Maine will not exceed $100 million. Investment spending will, of course, be passed on throughout the regional and national economies; hence, it is reasonable to assume that Maine's total income from the construction of the proposed project will amount to a maximum of $200 million between 1964 and 1970. This annual average increase in income of $33 million will increase projected 1965 income by approximately 2%, and projected 1970 income by approximately 1.8%. While

these additions to income would exert an important upward pressure on the construction industry and the wholesale and retail trades, we do not believe that they would exercise a significant influence on the course of Maine's economic development. In this connection, an announcement that the tidal project would be undertaken might lead to a curtailment of plans to increase private thermal and hydroelectrical generating capacity to a degree that would substantially offset the effects predicted above. In short, the Passamaquoddy power project seems likely to have a very small impact on the Maine economy as a whole. The economy of Washington County, however, would be temporarily transformed by the influx of several thousand workers and the generation of new income of at least $7 million in wages alone.

Although employment would be increased and trade and residential construction temporarily stimulated, the long-run effects of the construction would not, in our opinion, be sufficient to set in motion forces that would fundamentally change the nature of Washington County's economic problems. In fact, the higher wages accompanying the increase in economic activity might reduce employment and output in the garment and food-processing industries to the permanent detriment of the county's economy.

Our studies indicate that the impact of the operation of the proposed power project would not be significant unless electric power were made available to industry at a rate of 3.5 mills per kilowatt-hour. In this event, we believe that electrometallurgical plants, which would provide direct and indirect employment for about 2000 workers, would be attracted to Washington County.[1] This would, of course, lead to the establishment of Washington County as an important industrial area and provide an important new source of employment and income. Maine's locational disadvantage would not, however, be overcome by low power costs, and the course of economic development in the state of Maine as a whole would not in our opinion be significantly affected.

1. See Introduction to Part Two.